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CONVAIR DIVISION OF GENERAL DYNAMICS CORPORATION

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FACILITIES DESIGN CRITERIA
FOR
LAUNCH AND SERVICE BUILDING AT
OPERATIONAL DEVELOPMENT TEST SITE
(ODTS), VANDENBERG AFB

REPORT NO. ZL-7-037

14 November 1958

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wit... ...proval of:
Hq SAMSO, LA., Ca. 90045
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FORM NO. A-700-2

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INTRODUCTION

The technical design criteria included in this document represents those standards of the WS107A-1 for which the Operational Development Test Site (ODTS) facilities are to be designed. This report is submitted in accordance with AFBMD-MCPTC-6-181-E TWX dated 28 October, requirements as amended by AFPR TWX to AMC, #SARSMC-10-206E dated 3 November 1958. The criteria is based upon a 3 by 3 Complex configuration.

The facility criteria requirements presented in this report are intended to provide sufficient detail for the design for a Launch and Service Building to be used for the operational development testing and evaluation of Atlas Missile and its associated Ground Support Equipment by Convair-Astronautics.

The data includes inputs from Associate Contractors as specified for the Fairchild squadron and/or Complex 65-T criteria. These contractors include North American Aviation/Rocketdyne, Arthur D. Little, General Electric (Re-entry Vehicle), Kellogg Switchboard and Supply Co. and Sundstrand Turbo. The All Inertial Guidance (AIG) system inputs are provided by the American Bosch Arma Corp.

It should be noted that any change in the design criteria and technical data affecting other AIG-Series "E" sites will apply to ODTS. Therefore subsequent revisions to this document may be expected.

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1. DESIGN OBJECTIVES

1.1 CONCEPT

The Operational Development Test Site (ODTS) planned for Vandenberg AFB will consist of one Launch Operations Building and one Launch and Service Building. The site will be used by civilian test personnel concerned with evaluation and development of the Weapon System 107A-1. The testing will include all phases of maintenance and operations performed in conjunction with Series "E" Atlas Missile and the All-Inertial Guidance (AIG) systems. The following ground rules establish requirements for evaluation and test facility.

1.1.1 The buildings will not be hardened to the extent of the Fairchild installation but will provide personnel protection from hazards associated with accidental explosions from other complex installations in the area.

1.1.2 The facility will be as austere as practicel, consistent with personnel safety requirements.

1.1.3 The general arrangement of operational support equipment located within the building will be similar in detail to the Fairchild installation.

1.2 TEST REQUIREMENTS

The test program will consist of performing various tests on ground support and missile systems equipment for the following:

1.2.1 Improvement and simplification of the operational procedures.

1.2.2 Evaluation and proofing of major improvement changes to the GSE prior to incorporation into production.

1.2.3 Evaluation and proofing of modifications of the GSE necessitated by missile improvement.

1.3 FIRING REQUIREMENTS

1.3.1 Missile launchings will be made periodically for the purpose of determining that the development and improvement changes to the weapon system are satisfactory.

1.3.2 Short duration static firings will be conducted from launcher for evaluation test not requiring actual flight environment.

1.3.3 Television monitoring of missile operation will be required.

1.3.4 Special test instrumentation equipment and space will be provided.

1.3.5 Flame deflector and fire control systems will be similar to the Complex 65-T installation.

1.3.6 Provisions will be made for accommodating the Instrumentation Range Safety System (IRSS) equipment requirements applicable to Vandenberg AFB activities.

1.4 REFERENCES

1.4.1 Convair-Astronautics Report No. ZM-7-357 "Operational Ground Support Equipment" (Figure "A" List)

1.4.2 Convair-Report FT 3287 (Rev. B) "General Requirements for WS107A-1 IOC Type Facility Complex 65 ODTS".

1.5 GUIDANCE SYSTEM DESCRIPTION

1.5.1 The guidance system is an All-Inertial type manufactured by the American Bosch Arma Corporation (ARMA). With this system the missile flight is controlled entirely by equipment contained in the missile.

1.5.2 With the exception of approximately 50 wires for data and control links to the Launch Operations Building, the target constant modules, mobile test set, and ground support equipment (GSE) for the guidance system is located in the Launch and Service Building. This equipment affords the capability of both launch and checkout of a missile installed on the Launcher.

1.6 INSTRUMENTATION

1.6.1 GENERAL

The extent of instrumentation to be incorporated at this site has not been clearly defined at this time. Additional data will be provided at a later date.

1.6.2 It is expected that television monitoring and motion picture documentation will be included. Preliminary requirements have specified approximately six movie and TV Pads will be required. This would involve the installation of conduits to the various locations for control purposes.

1.6.3 Other instrumentation items will include termination and cathode follower type equipment. Power requirements are not available at this time and will be supplied at a later date.

2. SITING

2.1 GENERAL

The proposed location of the ODTS site is mid-way between Complex 65-2 and the proposed Complex 65-T. The relative distance between the Launch Operations Building and Launch and Service Building will be approximately 600 feet to be consistent with Fairchild layout as planned. The launcher will be oriented to the missile's centerline of fire trajectory.

2.2 GUIDANCE

2.2.1 The launcher area is to be located by high-order survey for determining accurate locations of erected missile, alignment stations and bench marks relative to geographic North. It is required that the star Polaris be visible by line-of-site from alignment stations. Other line-of-site requirements are from alignment stations to the Missile Guidance System (MGS) in both horizontal and erected missile positions and the associated optical bench marks.

2.2.2 The Launch Operations Building will be located according to the following considerations:

(a) Line-of-site between launch operations and launcher areas for television and/or visual monitoring of activities.

(b) Line-of-site of both launch operations and launcher to Vandenberg IRSS installations.

(c) Water and Electrical Power utilities location and accessibility.

(d) Interference of other Complexes and other right-of-ways within the confines of the base.

3. CIVIL CRITERIA

3.1 GENERAL AREA PLAN

The establishment of ODTS at Vandenberg AFB will consider the following:

3.1.1 Topography is to allow proper drainage of fluids dispensed during a normal static firing or missile launch operation.

3.1.2 Power plant and pumphouse location and routing of these utilities to the complex.

3.1.3 Relative location of reference bench marks required by the All Inertial Guidance system.

3.1.4 Accessibility to complex from maintenance and administration areas on the base.

3.1.5 Location to be consistent with requirements established by Instrumentation Range Safety System and associated installations.

3.2 ACCESS ROADS AND PARKING AREAS

3.2.1 The Access road required from maintenance and administration areas to the launch complex is to accommodate the missile handling trailer with eight wheels and tractor.

(a) Tractor-Trailer overall length approximately 1100 inches and width of 190 inches.

(b) Minimum height with vernier engine is 15'-3". Minimum height without vernier engine is 13'-10".

(c) Total weight of missile and trailer approximately 37,500 pounds.

(d) Trailer wheel base of 747 inches and 38 inch road clearance in center of trailer.

(e) Grade change limitation from up-grade to level to 17%.

(f) Surfacing suitable for high speed requirements of type III Mobility (50 mph).

(g) Accelerations not to exceed 2.5 g's positive and .5 g's negative.

3.2.2 Adequate paved surface must be provided around the Launch and Service Building for maneuvering and parking of propellant and gas servicing equipment, and for missile entrance and egress from the Missile Storage Area. It must be assumed that all servicing and maintenance vehicles are in the area at the same time.

3.3 FENCING

Safety fencing or guard rails will be provided in all hazardous areas such as transformer banks, flame deflector, drainage ditch, etc.

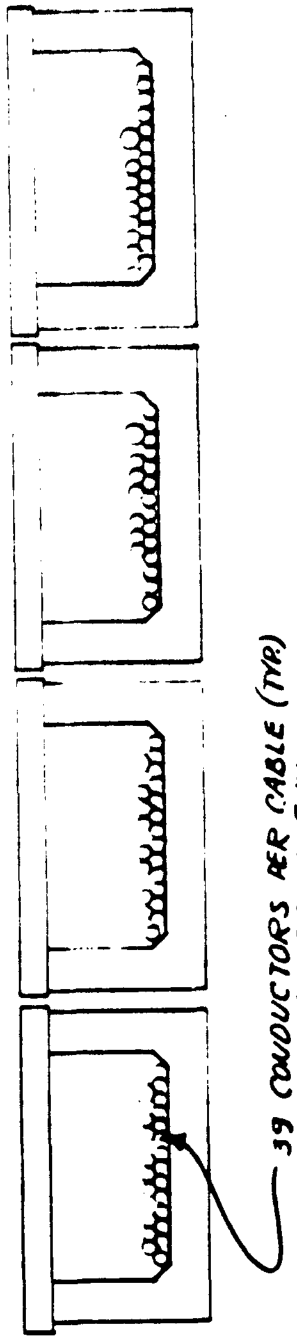
3.4 INTERCONNECTING CABLEWAYS

3.4.1 A cableway must be provided between the Launch Operations Building and each launcher to provide physical support and protection from the elements for wires and cables associated with the launch control and checkout equipment. It is estimated that 4000 wires will be required for launch control and checkout of each launcher. Most of the wires will be in 39 conductor cables (1.25 inches in diameter).

3.4.2 The cableways, consisting of precast concrete shapes, will run above ground on berms. When necessary to run underground, consideration should be given to drainage, accessibility, etc. Cableway details are shown in Fig. C-2 & C-3.

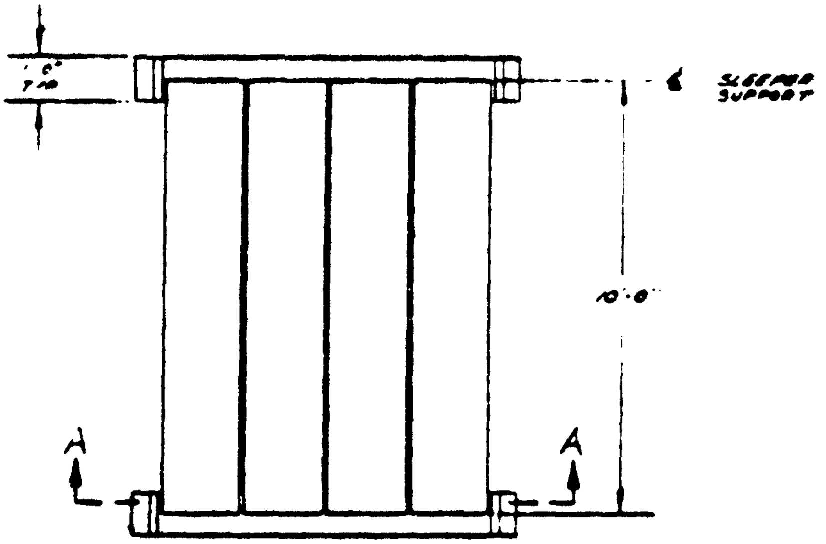
3.4.3 Changes in direction (either vertical or horizontal) of the cableways should be kept to a minimum. Abrupt changes in direction should allow for cable flexibility restrictions.

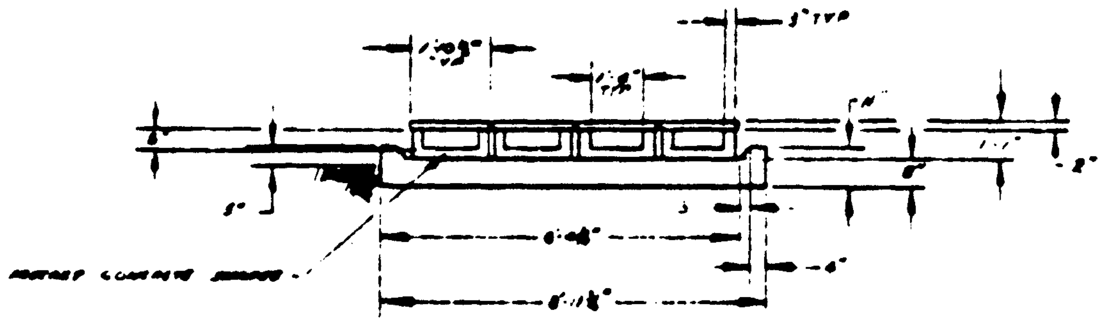
3.4.4 Cables will enter the crawl space under the Launch and Checkout Equipment Room direct from the cableways. Cable access details are shown in Fig. C-4.



CABLEWAY DETAIL
SCALE 1" = 1'-0"

FIGURE C-2

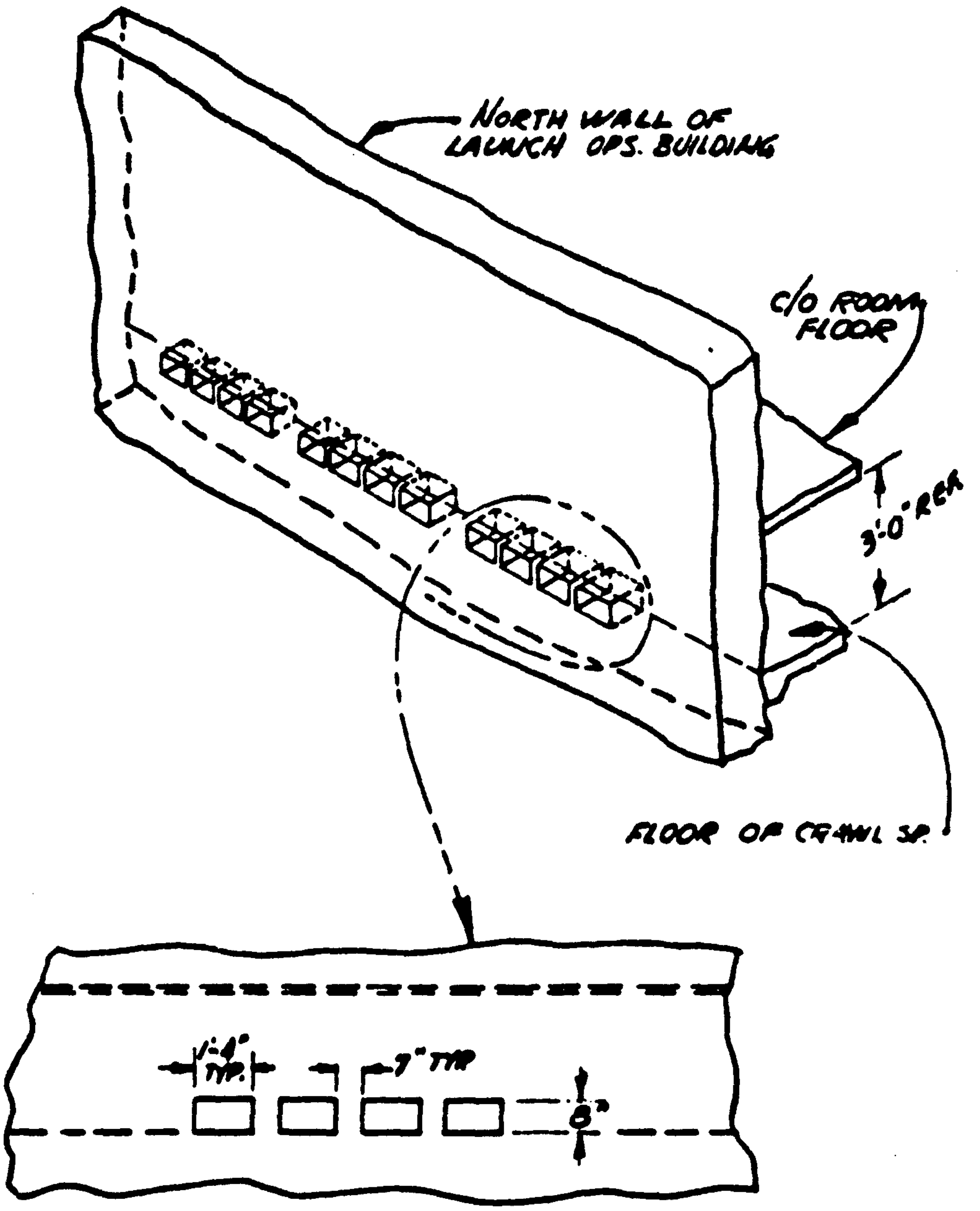




SECTION A-A

TYP
CABLEWAY

FIG. C-3



CABLEWAY ENTRANCES

FIGURE C-4

4. ARCHITECTURAL

4.1 GENERAL

4.1.1 The Launch and Service Building will contain ground support equipment and fixed facilities necessary to test, erect, service and launch a missile. The missile will be maintained in a horizontal position except for active countdown and infrequent sightings of Polaris from alignment station. Umbilical connections, instrumentation and service lines will be attached to the missile to provide control and test recording from Launch Operations Building during checkout, static firing and active countdown.

4.1.2 General layout of Launch and Service Building will be similar to Fairchild AFB sites to present actual environment for testing purposes. (See Fig. A-1). The basic elevation grade level will necessarily be altered to accommodate the 65-2 type flame deflector for refire and static test capability. Propellant and high pressure gas loading will be accomplished on grade level. Missile loading will also be at grade level. Earth fill and retaining walls will be utilized according to the minimum hardness requirement with exception of the flame deflector opening. Propellant and gas storage areas may be partially or entirely earth covered except for loading points.

4.1.3 Missile envelope for handling, maintenance and guidance system alignment equipment will require 2550 square feet. Overall length of 104 ft. 8 inches and minimum of 20 feet width and height clearance shall be maintained. A machinery platform approximately 12 feet deep at 13 feet 4 inches above pad level will be required for erection mechanism motors. This platform will be located at the flame pit end of the missile storage area.

4.1.4 Room envelopes for support equipment will approximate the following: (See Fig. A-1)

(a) Hydraulic Equipment Area
(b) Power Sub-Station Area
(c) Air Conditioning and Ventilating Equip. Area
(d) Mechanical, Electrical & Electronic Equip. Area
(e) Fuel Control Area
(f) Nitrogen and Helium Area
(g) Liquid Oxygen Piping and Control Area
(h) Instrumentation

To Be Added

Overall total for Launch & Service Building will be approximately sq. ft.

4.1.5 Removable roof over missile and erection mechanism shall include the minimum area of 104'-8" in length and 20'-4" width. The removal time from closed to fully opened (90° movement) will be 30 seconds.

4.1.6 Access doors and openings will be in accordance with the following minimum schedule:

(a)	Missile storage area (missile loading)	17'-0"X17'0
(b)	A.C. & Ventilating Equipment	5'-0"X STD. HT.
(c)	Mechanical & Elect. Electronic Equip. Area	5'-0 X STD. HT.
(d)	Liquid Oxygen Piping Area	8'-0 X STD. HT.
(e)	Nitrogen and Helium Area	4'-0 X STD. HT.

(f) Fuel Control Area 4'-0 X STD. HT.

(g) Other Area doors 3'-0 X STD. HT.

(h) Equipment Access Hatch to M&E Area 8'-0"X 13'-0" opening

(i) Instrumentation 5'-0 X STD. HT.

4.1.7 Roll-up door for flame deflector exhaust opening will be required for environmental protection of missile and equipment only. The maximum time required to fully open position will be 10 minutes, or minimum rate of 1 ft. per min.

4.1.8 Cabling to the Mechanical and Electrical Room will be routed under the electrical equipment platform. Hydraulic lines from Hydraulic Supply Unit to the stub-up plate will be carried in a trench below floor level. A small trench inter-connecting the Liquid Oxygen Control Room will be required.

4.1.9 Conduit runs within the Launch and Service Building between equipment is suggested in Fig. A-3. (To be added).

4.1.10 Conduit runs to TV & Movie Camera pads will be required.

4.2 MISSILE STORAGE AREA

4.2.1 The Missile Storage Area will be of sufficient size to perform routine maintenance function with the missile mated to the boom and launcher. Additional space will be provided to separate the booster section with the missile on its handling trailer within the enclosure. (See Figure A-1).

4.2.2 The Missile Storage Area entrance door may be hinged on either or both sides. There is no requirement for rapid opening of the missile entrance door.

4.2.3 Space will be provided on the Missile Storage Area walls for the Umbilical Junction boxes, AIG amplifier assembly, and a Nitrogen Charge Panel and instrumentation terminal panels.

4.2.4 A covered well will be provided 10'X10'X8' deep as shown in Figure S- . This will house the Guidance system optical alignment equipment collimator. Two bench marks in 4'X4'X8' rooms adjoining the collimator room. Provision will be made for sighting on the missile guidance pod, bench marks and the star Polaris with the collimator.

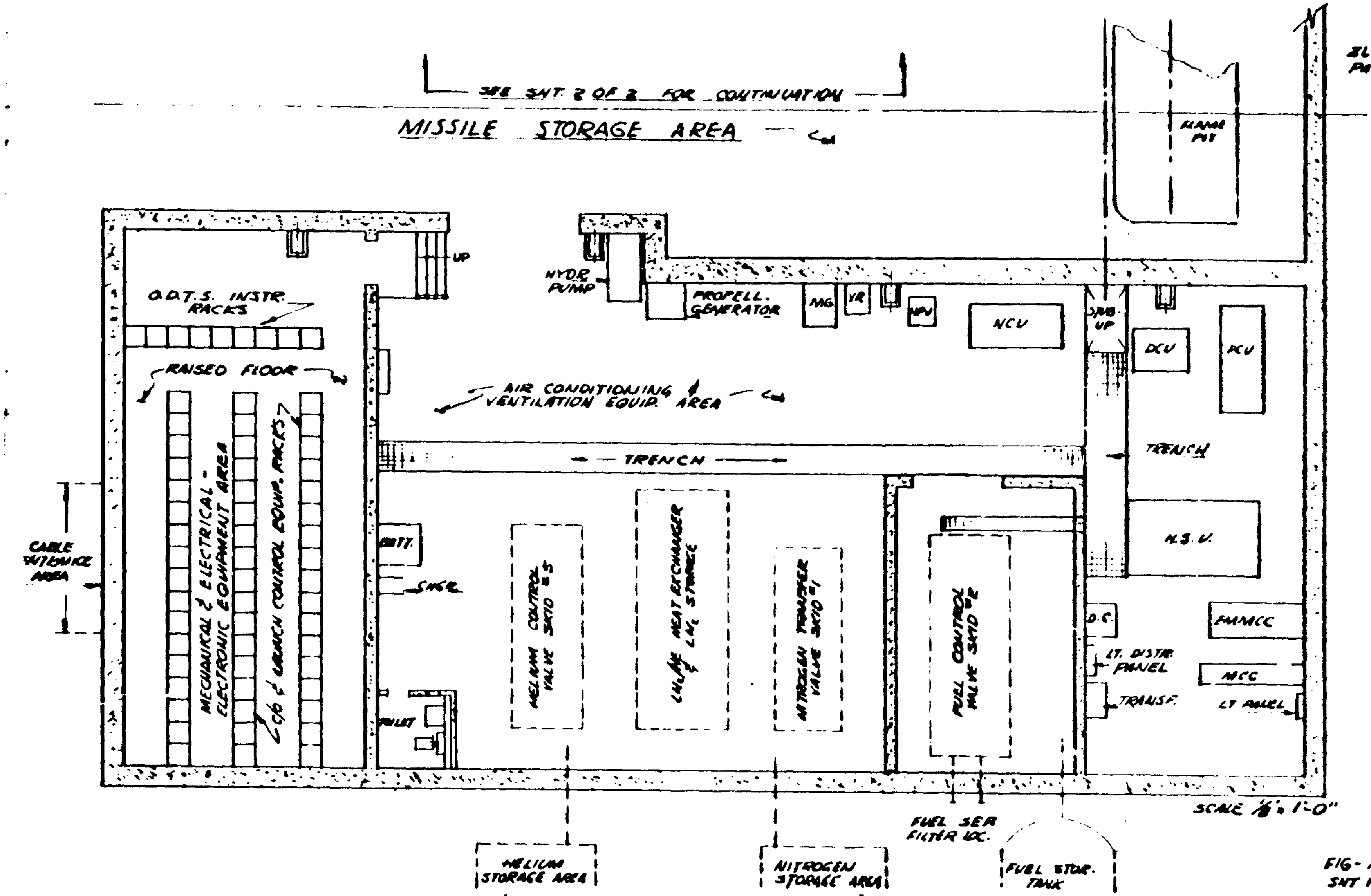
4.2.5 Blast protection will be required for exposed portions of collimator during static firing and repeated launchings from the site.

4.2.6 Two bench marks per collimator are to be provided.

4.3 MECHANICAL AND ELECTRICAL ROOM (Figure A-1)

4.3.1 The Mechanical and Electrical room will contain Instrumentation, Launch Control and Checkout Equipment racks, special electrical power equipment, Hydraulic Supply Unit, Pressurization-Control Unit, Dynamic Checkout Unit, Ullage Simulation Assembly, Nitrogen Control Unit, Erection Mechanism Motor Control Center (See Fig. A-4), and Hydraulic Power Unit.

4.3.2 A minimum of 11'-0" clear head room will be provided for piping, cable tray, and air ducts.



ODTS L&S BUILDING FLOOR PLAN (PRELIMINARY)

FIG-A1
SHT 1 OF 2

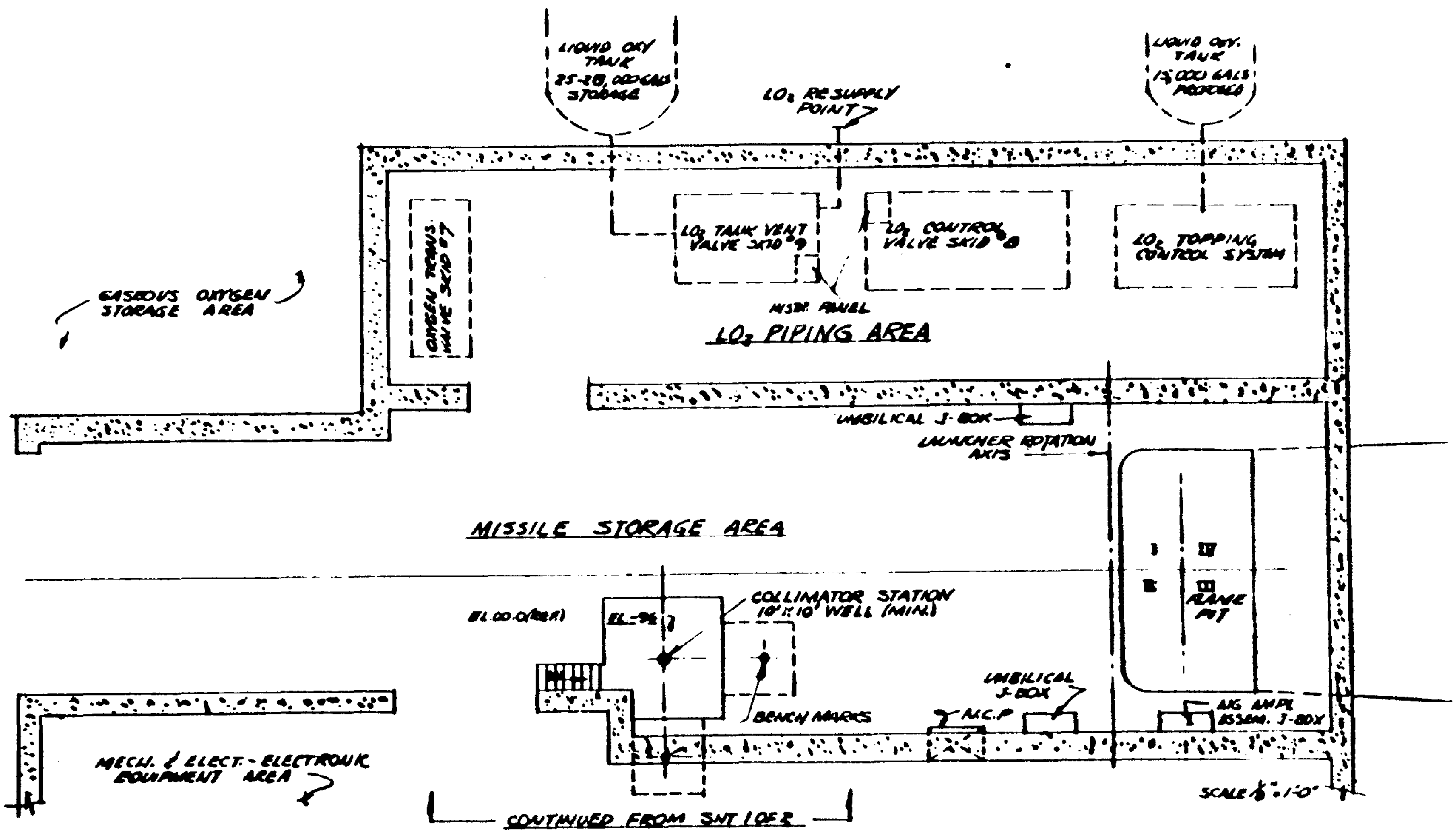


FIG-A-1
SHT 2 OF 2

OOTS - L&S BUILDING FLOOR PLAN (PRELIMINARY)

GROUND SUPPORT EQUIPMENT

C-30.2	-	Supply Unit, Hydraulic
C-24	-	Checkout Unit, Pneumatic Dynamic
C-31	-	Simulation Assembly, Ullage
C-26	-	Control Unit, Pressurization
C-25.1	-	Control Unit, Nitrogen
C-26.03	-	Charge Panel, Nitrogen
C-85	-	Motor Generator (400 cps)
C-87	-	Power Supply - DC
C-76	-	Battery Charger
C-77	-	Emergency Battery
NAA 18.1	-	Engine Flushing Module (IF REQUIRED)
HPU	-	Hydraulic Power Unit (Erection Boom)
NAA 10.4	-	Combustion Stability Monitor
NAA 9.1	-	Relay Assembly
C-80.6	-	Control Unit, Camera TV (65-T only)
C-53.6.0	-	Auxiliary Switching Unit, Launcher
C-51.1.0	-	Distribution Unit, Signal
C-51.0	-	Amplifier Unit, Line Driving
C-94.1	-	Power Supply Unit, Launcher
C-83.2.0	-	Measuring Unit, Pressure
C-80.5.0	-	Control Unit, Target Data
C-80.7	-	Control Unit, Ground, Autopilot
C-80.4.0	-	Exerciser Unit, Propellant Utilization
C-89.1	-	-Sequencer, Propellant Loading
C-64.5	-	Signal Responder, Launch
C-96	-	Switching Unit, Transfe., Launch Control
C-63.4	-	-Sequencer, Pneumatic Test
C-89.8.0	-	-Sequencer, Control Unit, Pressurization
C-89.7.0	-	Control Unit, Ground Power, Missile
C-95.1	-	Control Unit, Relay
APS	-	APS, Ground Support Equipment
C-79.1.0	-	Distribution Unit, Power
C-79.5	-	Distribution Unit, No. 1 Cable, Launcher
AIG	-	Arma Countdown Group
C-X	-	Erection Mechanism Motor Control Center (EMMCC)
C-79.3	-	Distribution Unit No. 2, Cable, Launcher
IRSS/CAB	-	Instrumentation Range Safety System, Cabinet
C-97.7	-	Cabinet, Spare
C-82.2.0	-	Junction Box, Umbilical, Right

Figure A-2a

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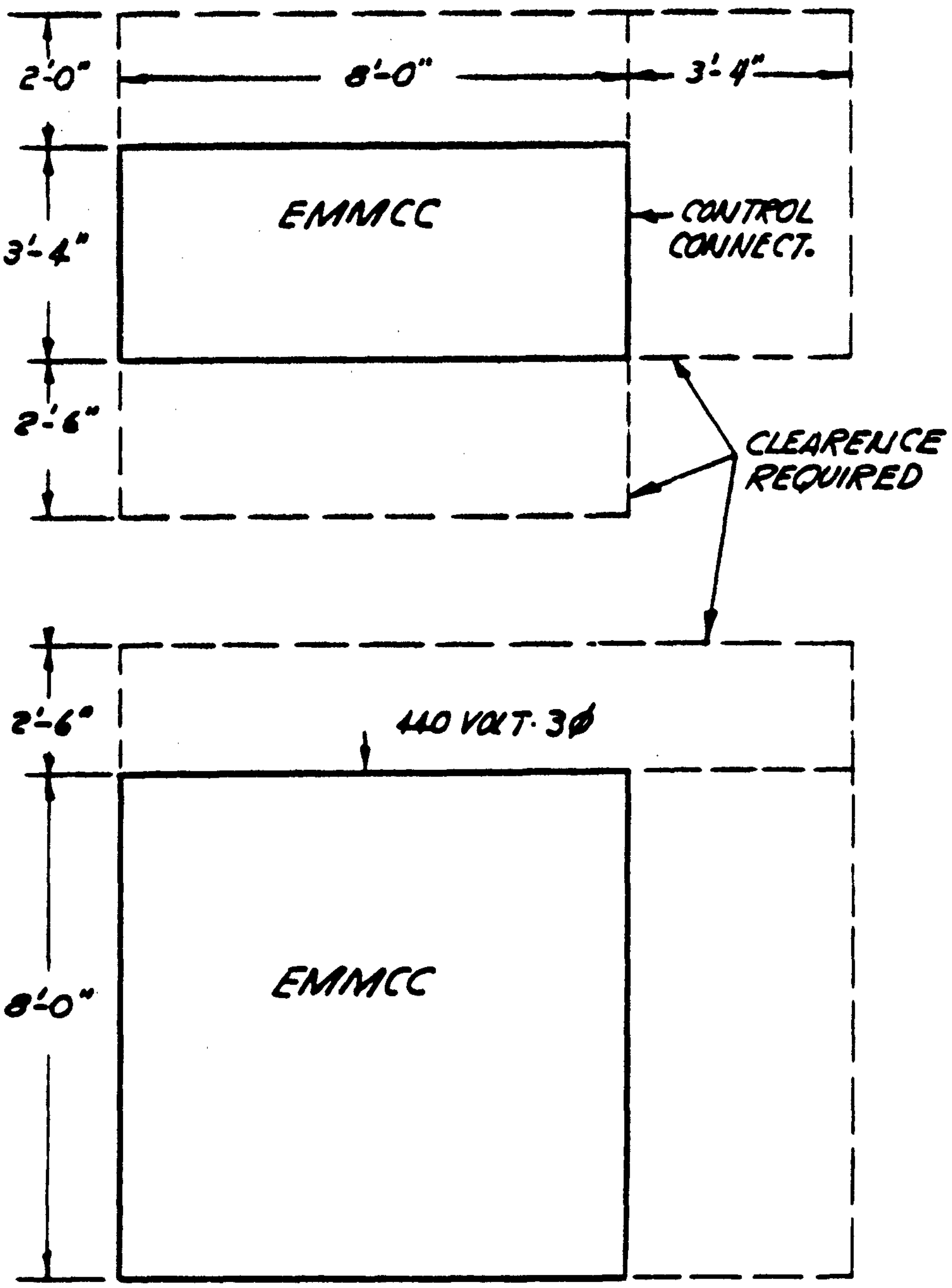
Figure to be provided later.

Figure A-3



ERECTION MECHANISM MOTOR CONTROL CENTER
FIGURE A-4

5. STRUCTURAL CRITERIA

5.1 GENERAL

5.1.1 The development of structural drawings must be done after careful perusal of other sections of this criteria and in accordance with data stated below.

5.1.2 Load point locations and load magnitudes are both subject to change, due to the preliminary design stage of the ground support equipment. When final configurations are established, information contained herein will be revised for final facility design.

5.2 MISSILE STORAGE AREA

5.2.1 The ODTS complex facility will have static and refire capability and engine exhaust pressure and temperature after launch will be a design consideration. The pressures and temperatures may be obtained from the following reports that will be available through AFBMD at a later date. It is recommended that the pressures found therein be increased by 25 percent to allow for future engine development.

(a) AZJ-27-004 TN - "Impingement Heating and Blast Load Pressures on Launcher and G.S.E. During Rise-Off, XSM-65 D&E, I.O.C. Missile", dated 6 August 1958.

(b) ZA-7-163 - "Horizontal Loads, Resulting from Missile Exhaust Gases", dated 26 June 1958.

(c) AZS-27-232 TN - "Method of Determination of Structural Resistance to Impingement Heating and Blast Loading on Launcher and G.S.E. During Rise-Off", Preliminary.

5.2.2 Flame Deflector Pressure: No information available at this time. Data will be added at a later date.

5.2.3 Thermonuclear Blast Considerations:

(a) Pressure: Information not available at this time. Data will be added at a later date.

(b) Ground Shock: Information not available. Data will be added at a later date.

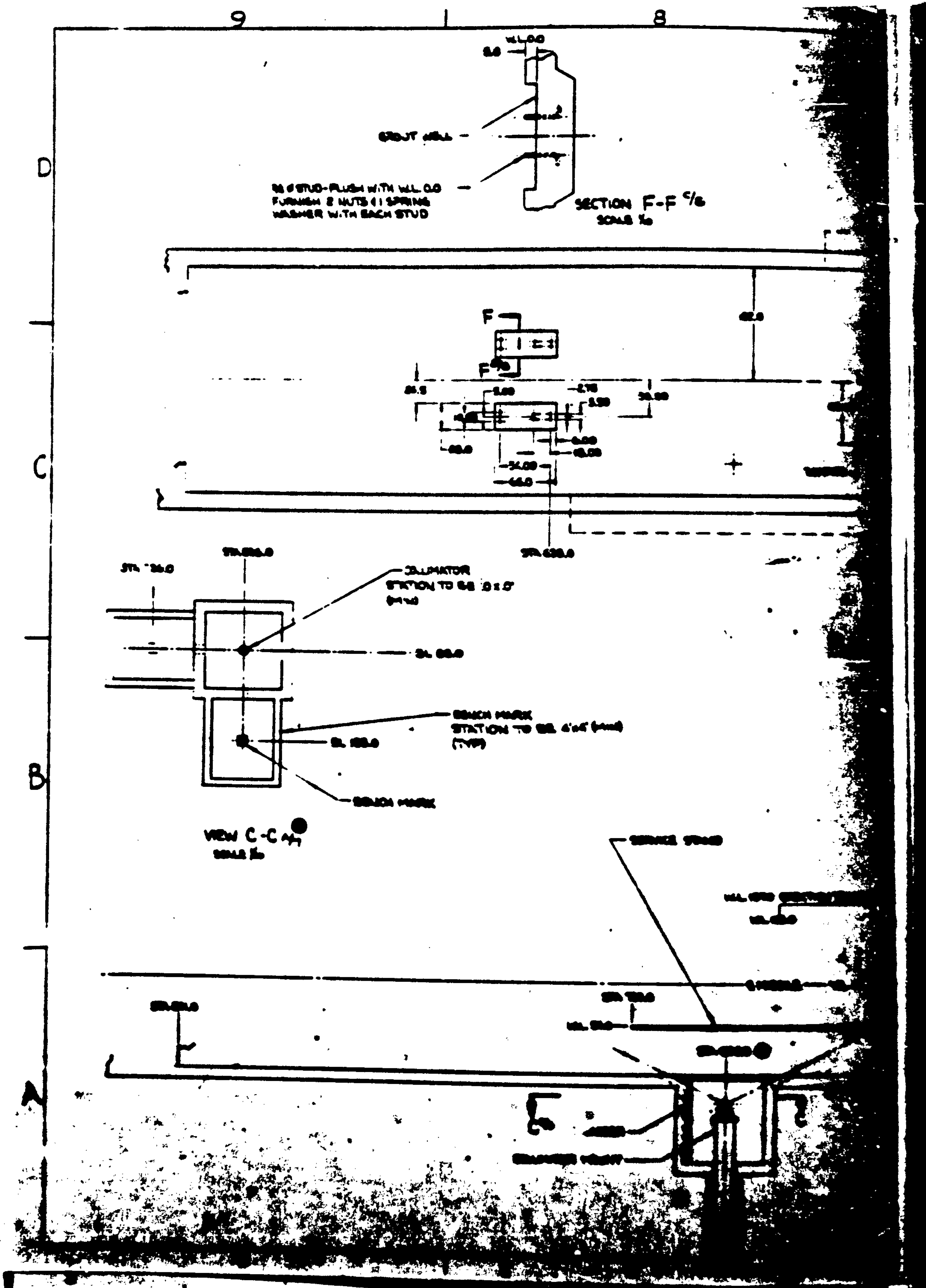
5.2.4 Maintenance Platforms

The facility shall provide retractable platforms for missile maintenance accessibility where shown in 27-09002. Six inch clearance from any part of the trailer, erection beam, or launcher must be maintained. Access ladders must be provided from the Missile Storage Area floor.

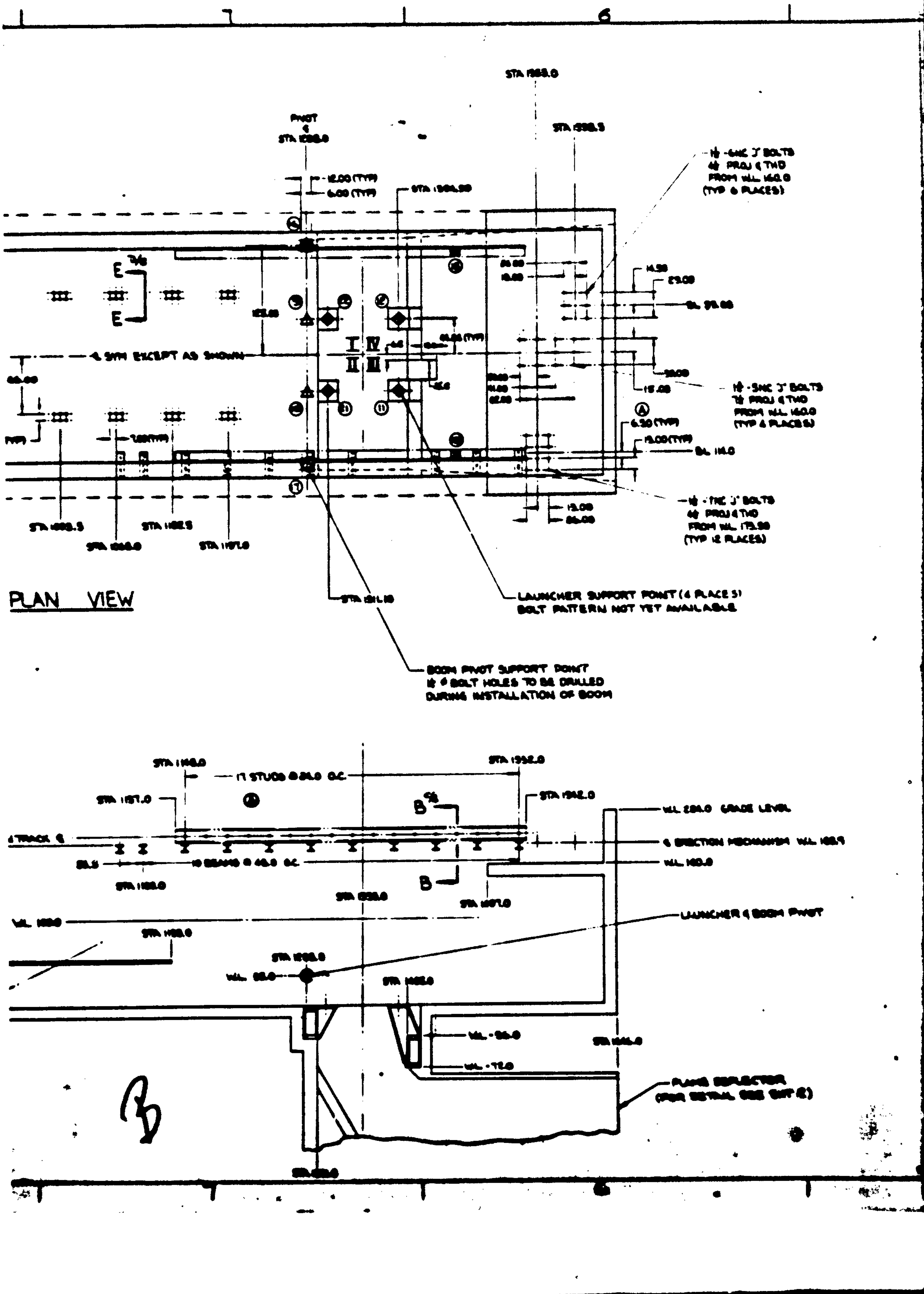
The platforms must withstand a uniform load of 40 lbs. per sq. ft. or a 2000 lb. load concentrated on a 2.5 sq. ft. area, whichever is more severe.

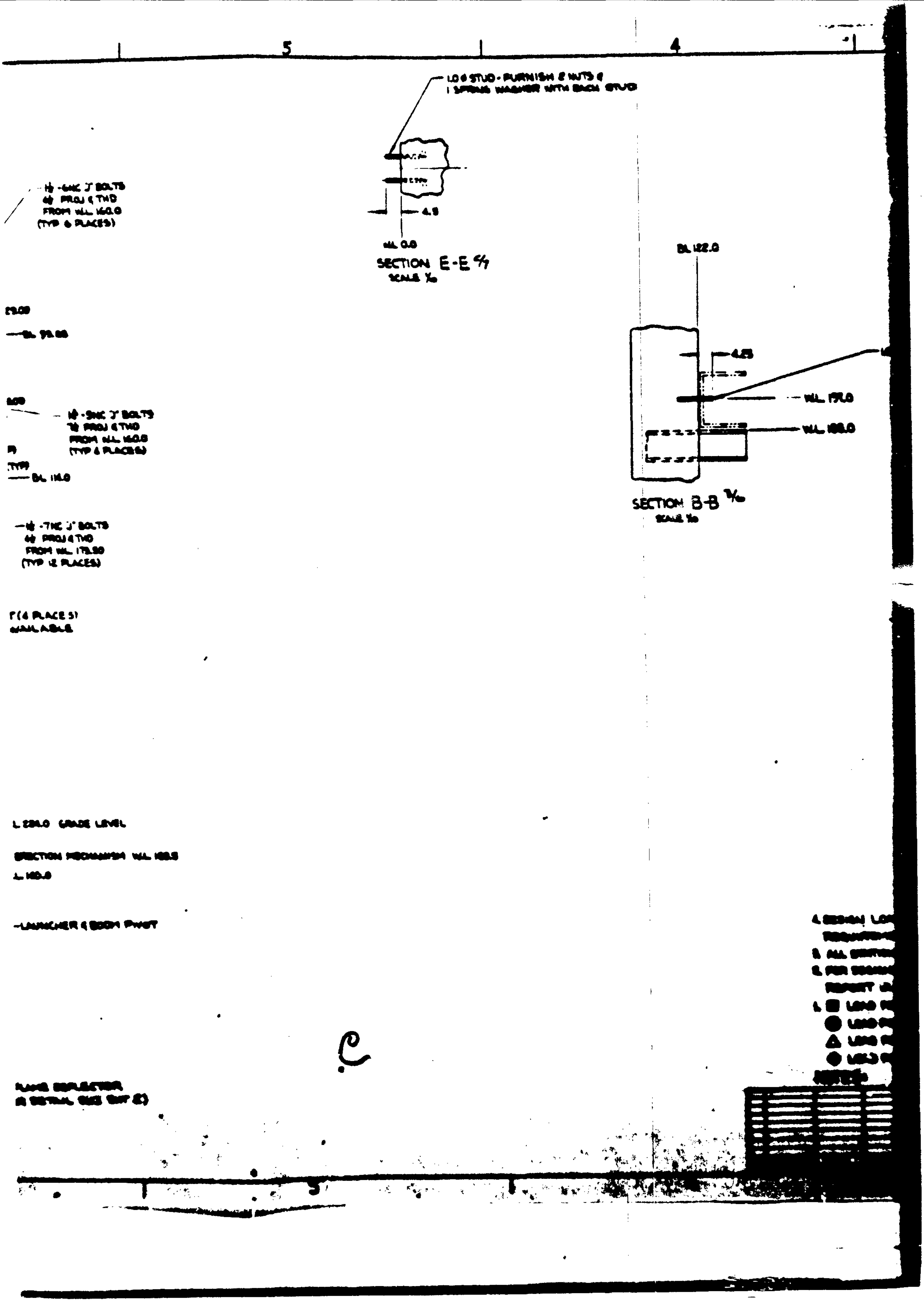
5.2.5 Configuration

Preliminary configuration of flame deflector and collimator are shown in 27-09002 drawing. The load points and configuration are not firm and subject to change.



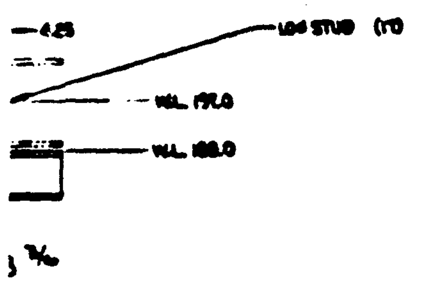
GROUT WELL
FURNISH 2 NUTS & 1 SPRING
WASHER WITH EACH STUD
SECTION F-F
COLLIMATOR
BENCH MARK
VIEW C-C
SERVICE STAND


PLAN VIEW
LAUNCHER SUPPORT POINT (4 PLACES)
BOLT PATTERN NOT YET AVAILABLE
BOOM PIVOT SUPPORT POINT
DURING INSTALLATION OF BOOM
17 STUDS @ 24.0 O.C.
W.L. 230.0 GRADE LEVEL
LAUNCHER & BOOM PIVOT
FLAME DEFLECTOR


5
4
SECTION E-E
SECTION B-B
BL 122.0
4.25
4.5
W.L. 0.0
(TYP 6 PLACES)
(TYP 12 PLACES)
GRADE LEVEL
LAUNCHER & BOOM PIVOT
5

3

2



4. DESIGN LOADS FOR GS-T ARE SHOWN IN STRUCTURAL REQUIREMENTS REPORT SL-7-092.
3. ALL STATION LINES SHOWN ARE MISSILE STATIONS.
2. FOR DESIGN LOADS SEE STRUCTURAL REQUIREMENTS REPORT SL-7-090.
1. ■ LOAD POINTS 18 & 19.
● LOAD POINTS 16 & 17.
△ LOAD POINTS 9 & 10.
◇ LOAD POINTS 11, 12, 21 & 22.

NOTES:

1

2

2

1

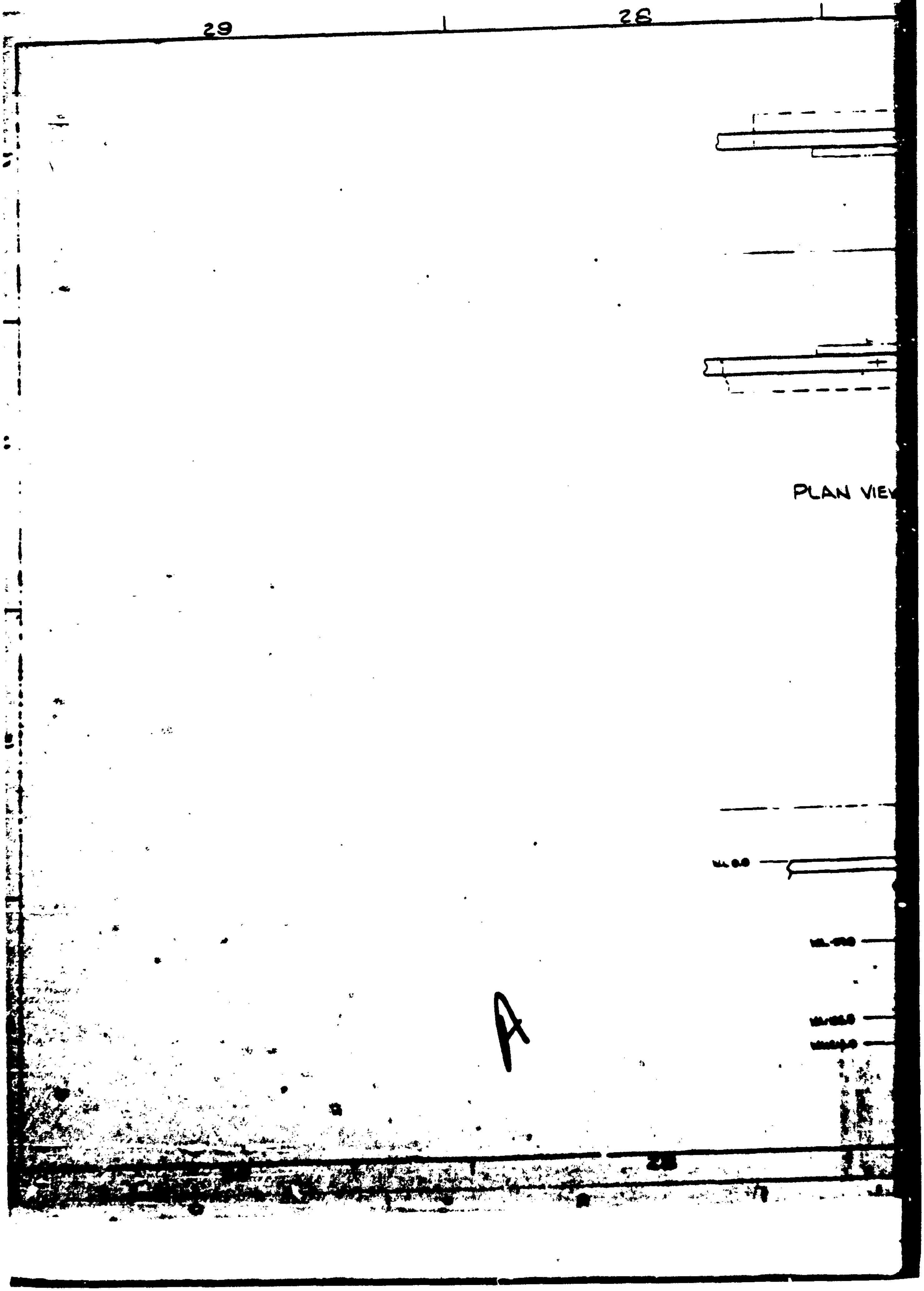
D

C

B

A

E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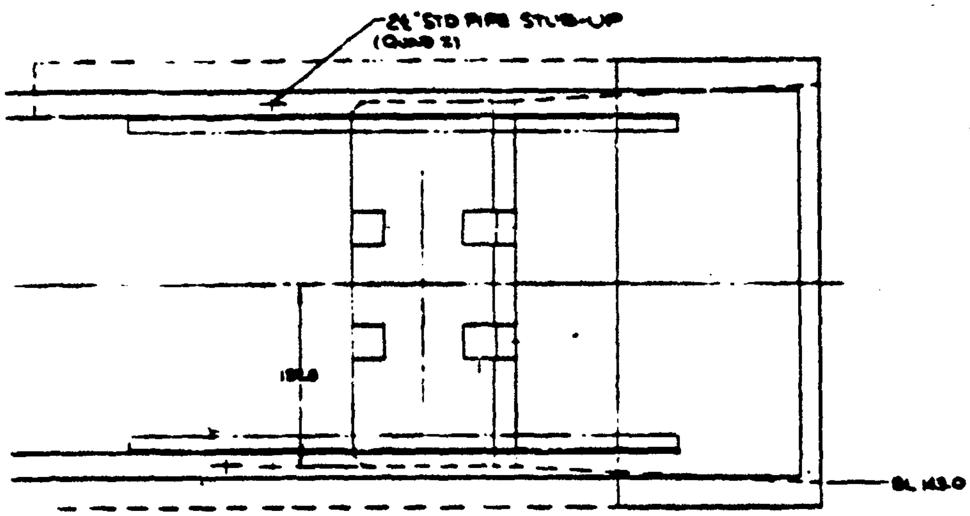
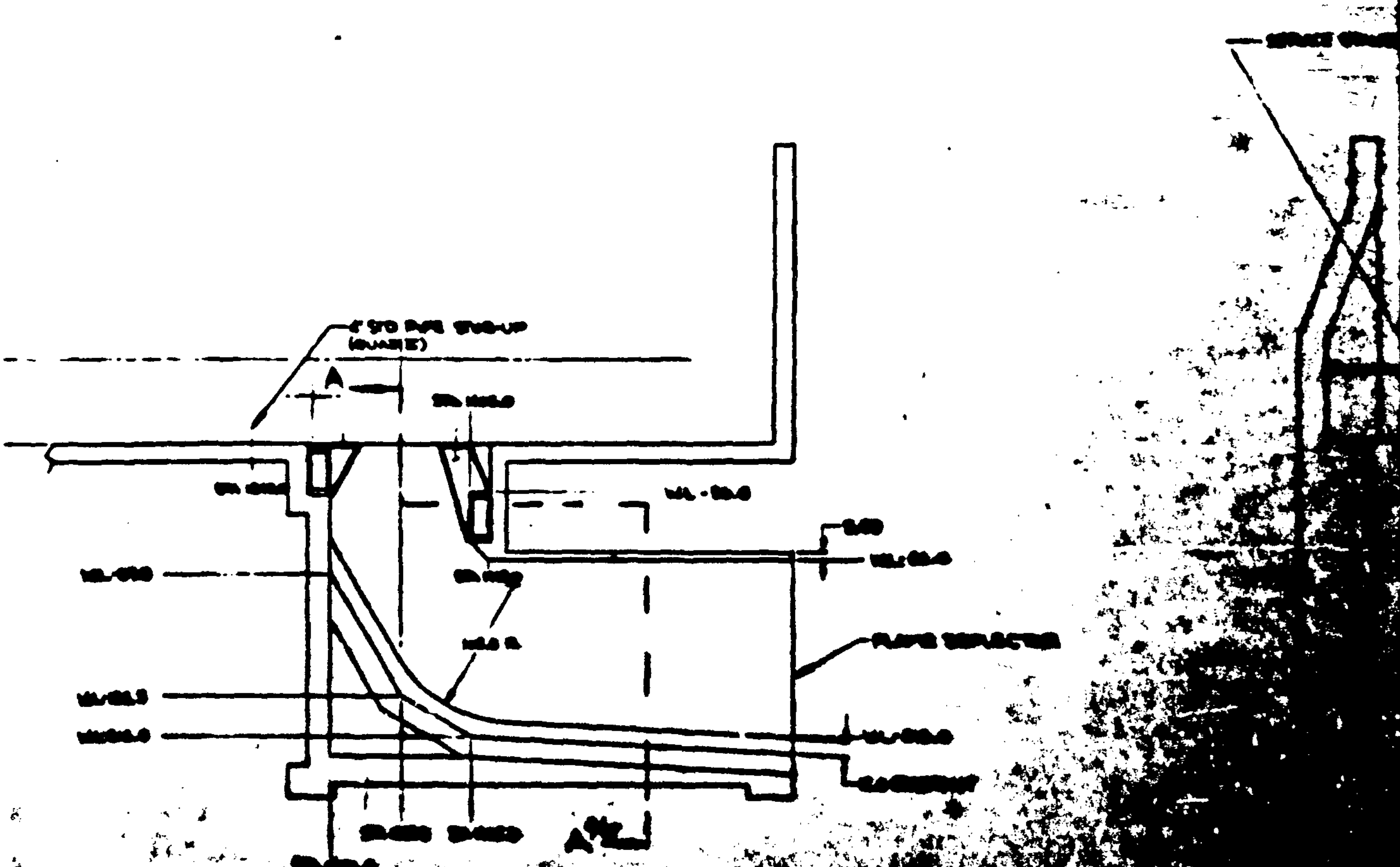


PLAN VIEW (PARTIAL)



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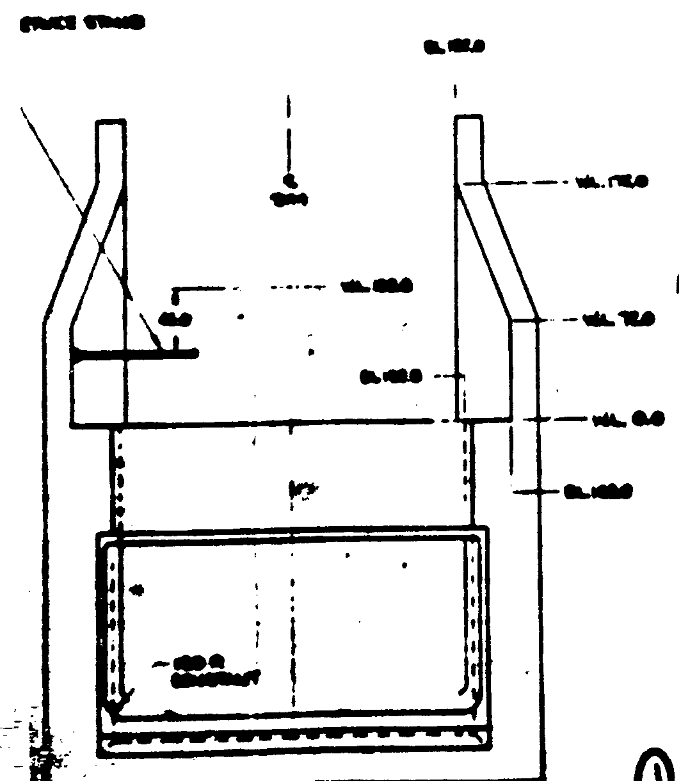

SECTION A-A

24 23 22

D

22

21

D

C

B

E

A

5.3 Stiffness Requirements: The launcher supporting Structure shall have a minimum stiffness defined by the following spring constant.

$K_z = 1.04 \times 10^6$ #/in (Vertical)

This value is the stiffness requirement for each individual support, namely Load Points 11, 12, 21 and 22. The vertical stiffness of these points shall be equal within 10%.

Spring constant, as used here, is defined as the force required to deflect the structure one inch in the vertical direction. It is not a requirement that the support must be capable of supporting the load or the deflection equal to the spring constant, but the ratio of the actual forces (as described in 5.4.4.2) to the spring constant gives the maximum actual deflection allowed.

$$\frac{P_{actual}\ \#}{K_{min}\ \#/in} = \Delta_{max.}\ in$$

$\#$ = lbs

5.4 Total Mass Requirements: Due to dynamic considerations the total mass of the substructure shall not be less than 300,000#. This mass shall consist of rigid material, such as steel and concrete, only.

5.5 COLLIMATOR ASSEMBLY

5.5.1 Structural design will consider the following requirements of the All-Inertial Guidance equipment due to ground shock.

(a) Collimator and Bench Mark rotational stability displacement (static) to be maintained at 2 seconds of arc maximum.

(b) Collimator rests on three pads individually attached to steel plates grouted to top of pedestal. Three studs imbedded in the pedestal provide hold down for collimator assembly. Weight of collimator approximately 1000 pounds.

(c) Bench Marks (two required) weigh approximately 10 pounds and are independently mounted on flat plate atop ground pedestals, each having a 1 foot mounting surface.

5.6 STRUCTURAL DESIGN LOAD REQUIREMENTS

Data included in Appendix A to be supplied at a later date.

6. MECHANICAL CRITERIA

6.1 ENVIRONMENTAL REQUIREMENTS

6.1.1 The equipment in the Mechanical and Electrical Room is designed to operate in an environment of +35°F to +110°F, 95% RH. It is recommended that a minimum temperature of +50°F and a minimum ventilation rate of four air changes per hour be maintained when personnel are performing maintenance in the building.

6.2 EQUIPMENT COOLING

6.2.1 Cooling air for Launch Control, Instrumentation, Test and Checkout Equipment and the missile equipment pod free of corrosion or explosive fumes and cleaned by standard mechanical filters. The air circuit shall be capable of operation independent of the refrigerant circuit.

6.2.2 Cooling air to Launch Control, Instrumentation and Checkout Equipment racks will be fed from a plenum underneath and be returned through a duct overhead. (Figure M-11). The system will be designed for 100% recirculation. (Figure M-8). Provision should be made to convert the system to 100% outside air remotely in the event of refrigeration failure. The system will provide a total of 4000 SCFM at 55°F ± 3°F, 65% RH max. Air average flow of 150 SCFM at 0.5" SP will be supplied to each rack as specified in Figure A-2. (TO BE SUPPLIED WHEN AVAILABLE)

6.2.3 Cooling air to the missile equipment pods will be fed to stubups on either side of the Missile Storage Area. (Exact location of these stubups has not been determined). The system will be designed 100% outside air. 1670 SCFM will be supplied at 40°F ± 5°F, 30" SP, at 50% RH (Fig. M-8). Additional 1000 SCFM at 40° ± 5°F will be required in the second pod for telemetering and range safety equipment. A smaller amount will be required to maintain proper conditioning of AIG equipment in pod during standby.

6.2.4 The Hydraulic Supply Unit requires cooling water from the building supply system. One - 2" supply line and one - 2½" drain line will be required. A maximum flow of 65 GPM of 40°F to 70°F water with 60 psig supply pressure is required. A total of 1000 gals. will be used during countdown.

6.3 FLUID STUBUPS (Figure M-7)

6.3.1 Fluids will be supplied to the missile (except propellants) through flexible lines and hard tubing contained in an 18" caisson which passes through the Missile Storage Area wall and the erection boom trunnion. This caisson is attached to and rotates with the launcher. The flexible lines on the Mechanical and Electrical Room end are attached to a fixed plate and from there are routed to the proper unit of Ground Support Equipment. A sleeve must be provided in the building wall in which the caisson will rotate.

6.3.2 Propellants will be supplied to the missile through three additional stubups. Exact location of these stubups are shown in Fig. M-12 and M-13.

6.4 FLUID REQUIREMENTS

6.4.1 Fluid storage will be adequate to support one missile through load hold one hour, unload, load, and launch. This must be accomplished after a ten day period of isolation commencing anytime in the resupply schedule.

The fluids supplied shall meet the following specifications:

Nitrogen	MIL-N-6011 Type I Grade A
Oxygen	MIL-P-25508
RP-1	MIL-F-25576
Trichlorethylene	NA2-01512

Helium - Convair Specification No. 0-73002

6.4.2 Liquid oxygen must be stored in sufficient quantity to provide approximately 171,000 lbs. on board at launch.

6.4.3 Liquid nitrogen use is 390 gallons during countdown plus 980 gallons for a one hour hold.

6.4.4 ~~200~~ gallons of trichlorethylene shall be stored at the launcher. (IF REQUIRED – WILL NOT BE FACILITY STORED)

6.4.5 RP-1 must be stored at a temperature between +35°F and 77°F. Approximately 75,000 pounds are required on board at launch.

6.4.6 Uses and recommended storage for gaseous nitrogen are shown in Figure M-9 (sheets one through three).

6.4.7 Uses and recommended storage for helium are shown in Figure M-10.

6.4.8 Instrument air at 300 psig is required by the Pressurization Control Unit at a flow of 0.6 lbs. per min. -65°F dew point.

6.5 PROPELLANT SYSTEM

6.5.1 GENERAL

The propellant-loading system for this complex will be designed by Arthur D. Little (ADL), Inc. of Cambridge, Mass. Propellant system schematic is shown in Figure M-1. Sub-system flow diagrams for Liquid Oxygen, Fuel, Liquid Nitrogen, and Helium as proposed is shown in figures M-2 to M-8 respectively.

6.5.2 Storage Vessel Requirements

See Figure M-14.

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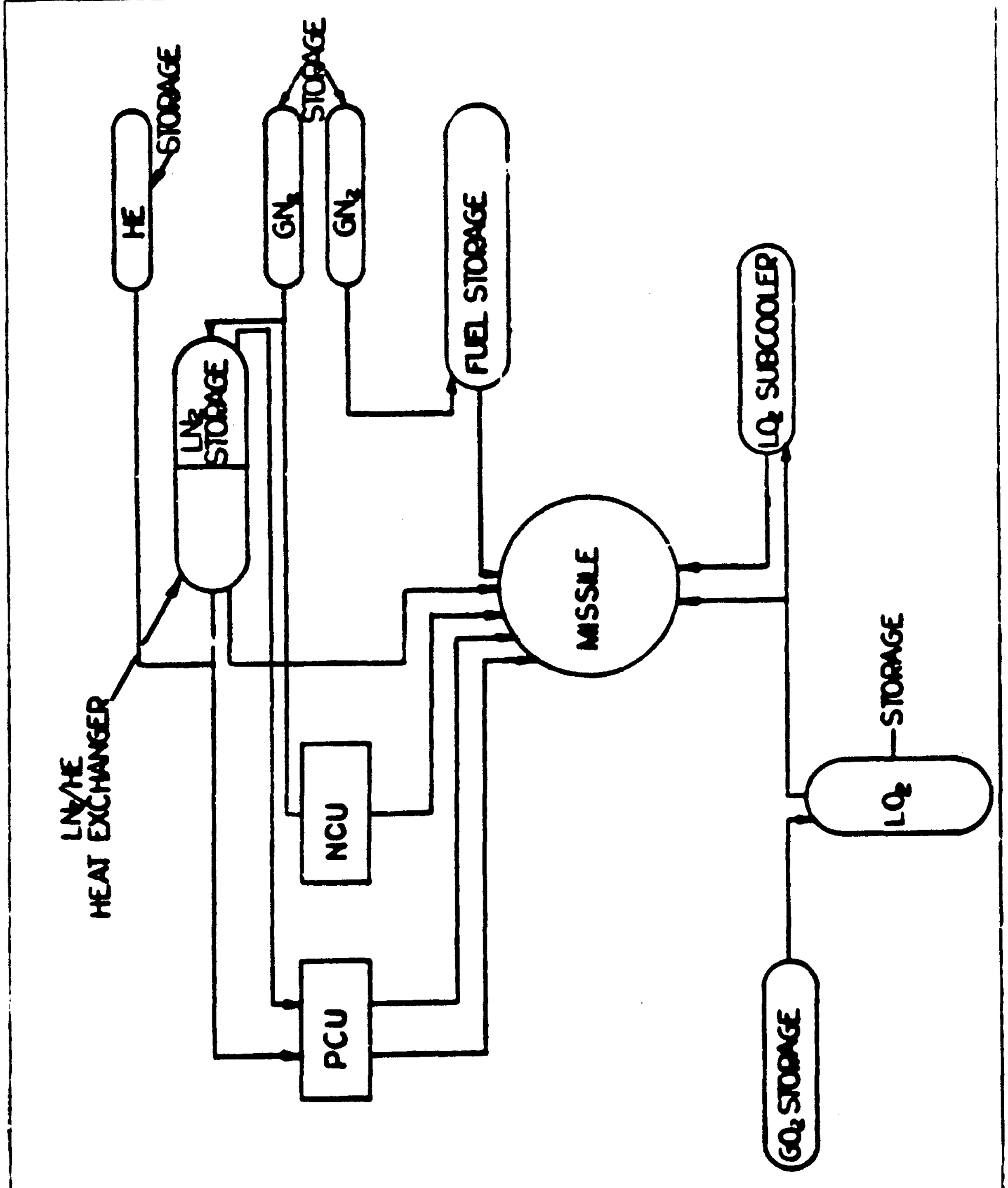
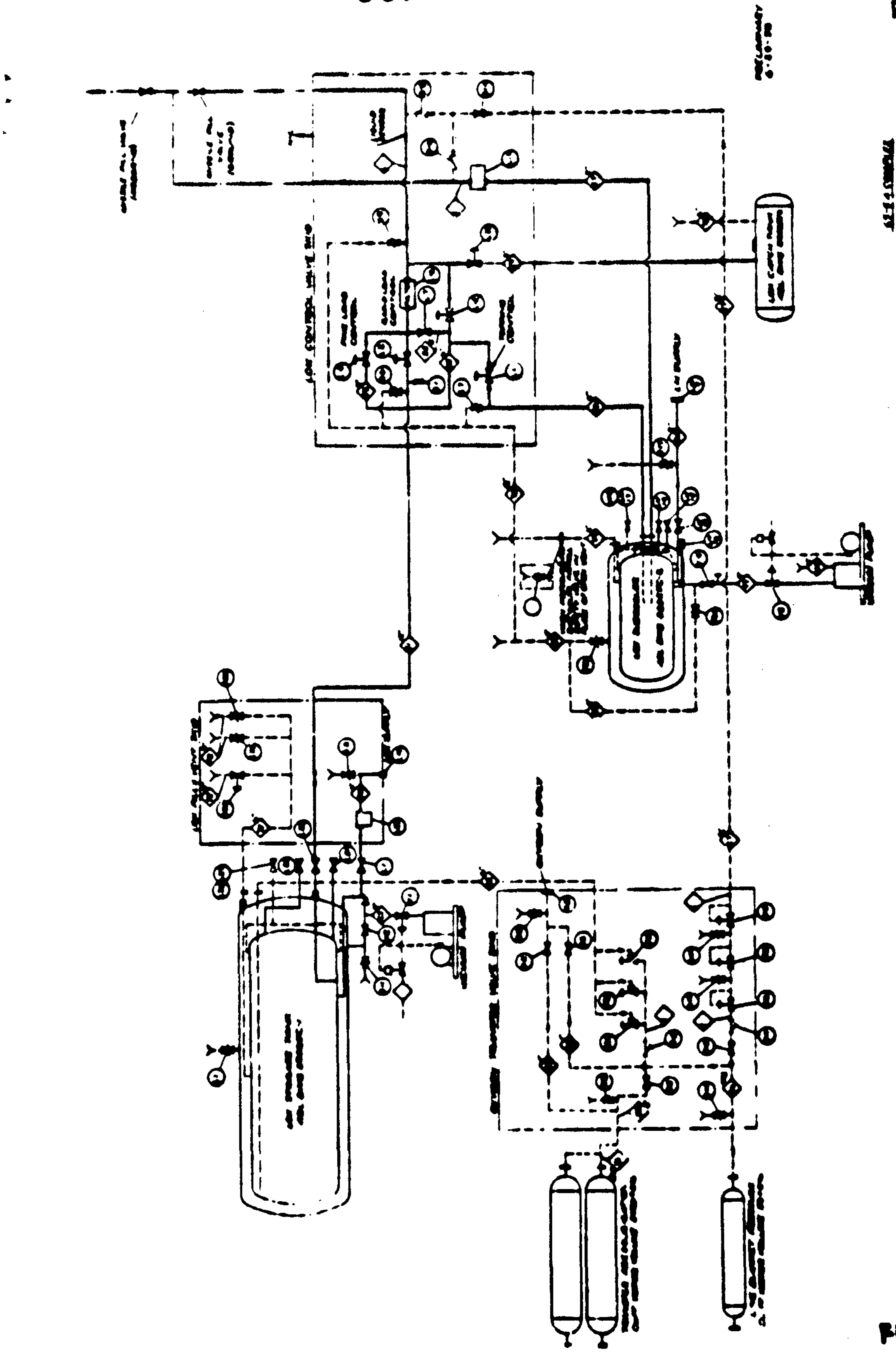


PROPELLANT SYSTEM SCHMATIC

FIGURE M-1

~~CONFIDENTIAL~~

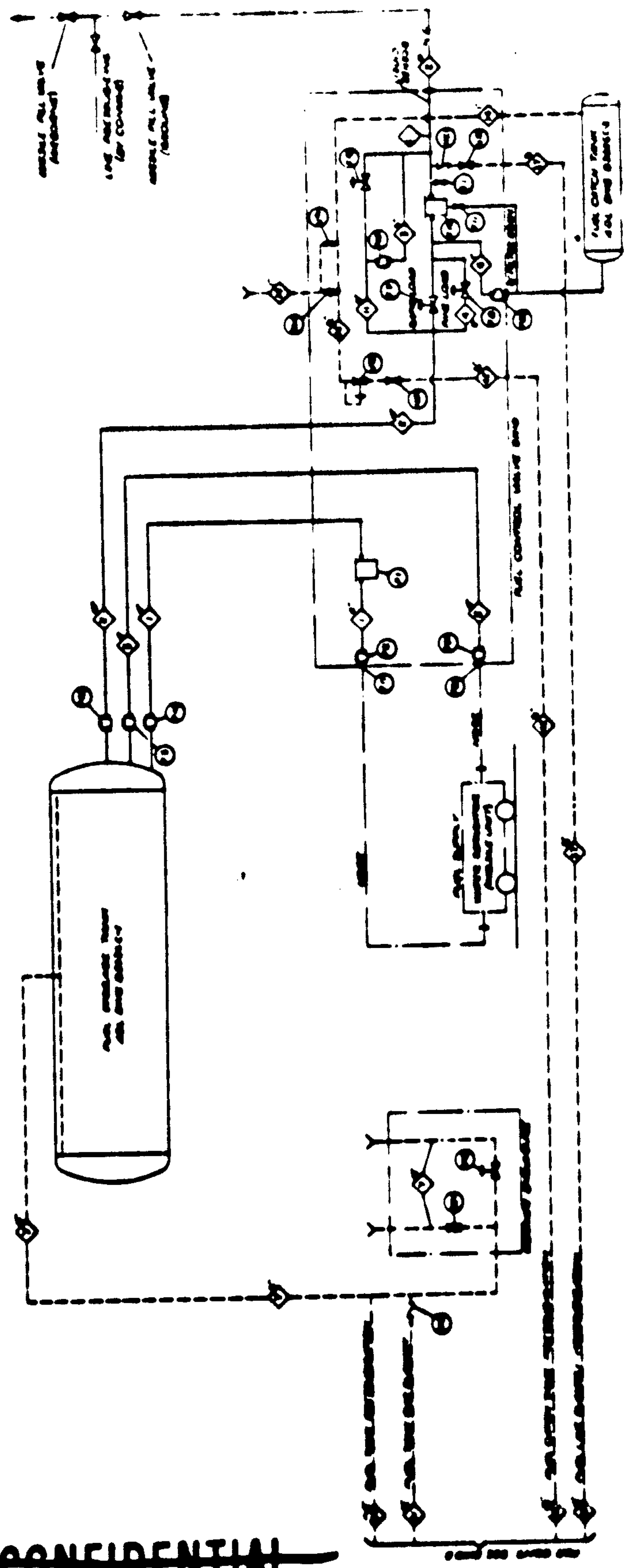


FLOW DIAGRAM OF LIQUID - OXYGEN SYSTEM FOR 65-T COMPLEX

FIGURE M-2

~~CONFIDENTIAL~~

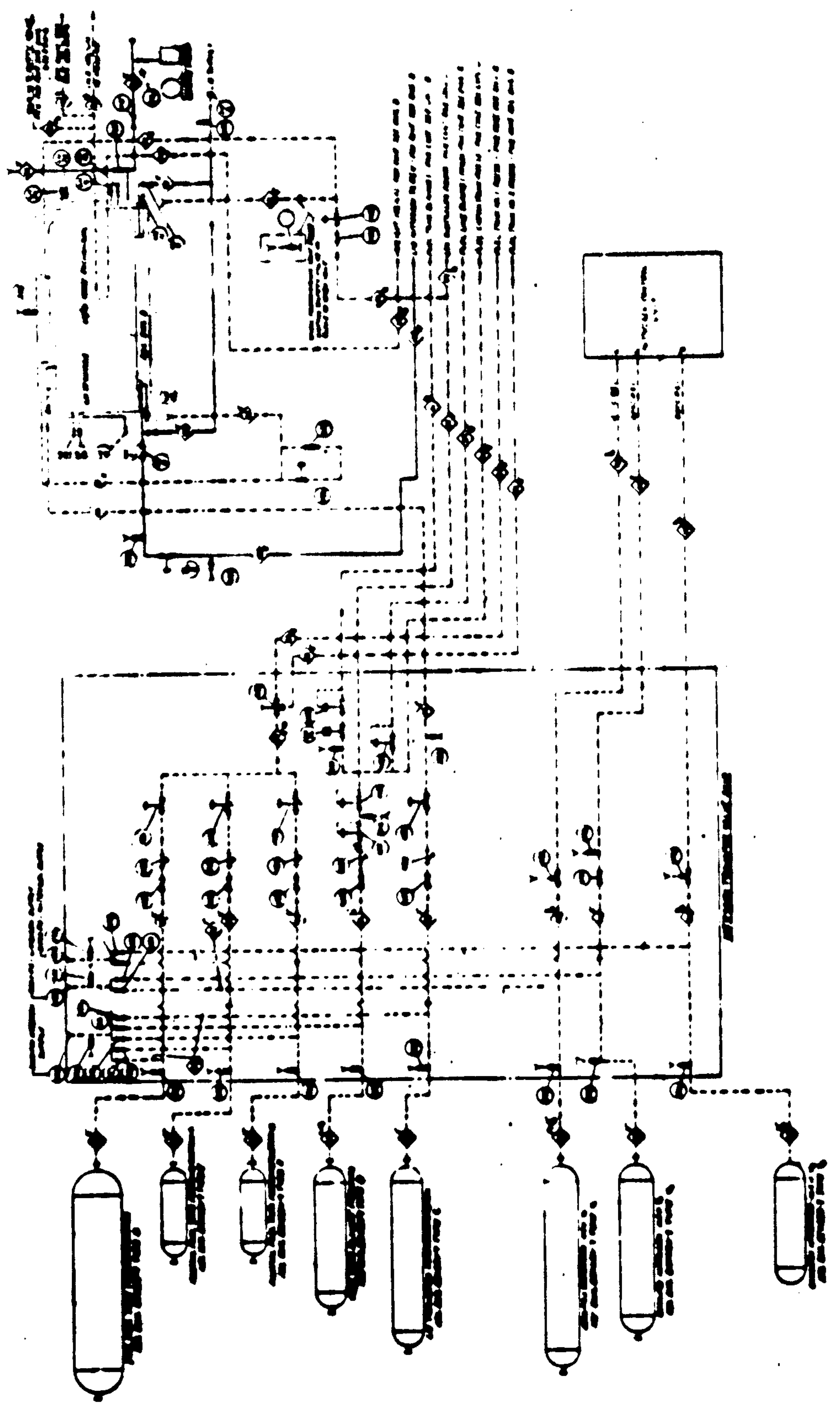
~~CONFIDENTIAL~~



FLOW DIAGRAM OF FUEL SYSTEM FOR 65-T COMPLEX

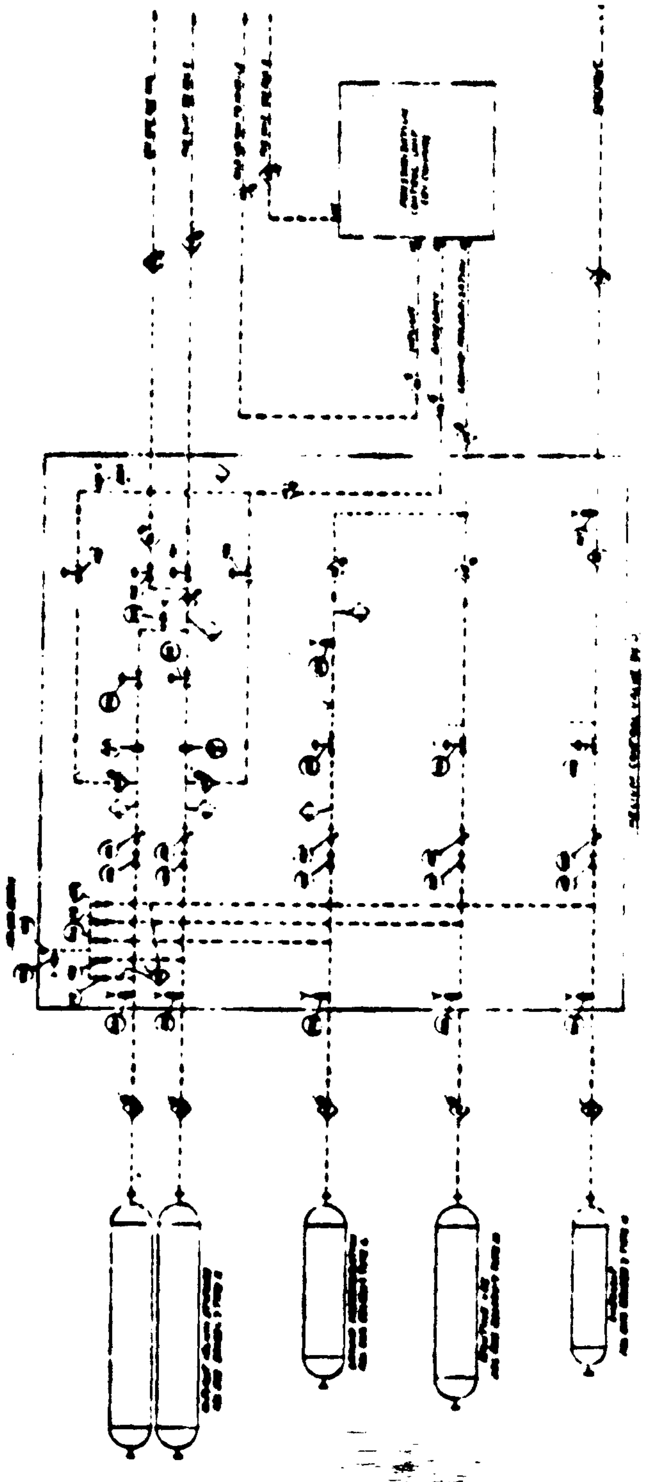
FIGURE M-3

~~CONFIDENTIAL~~



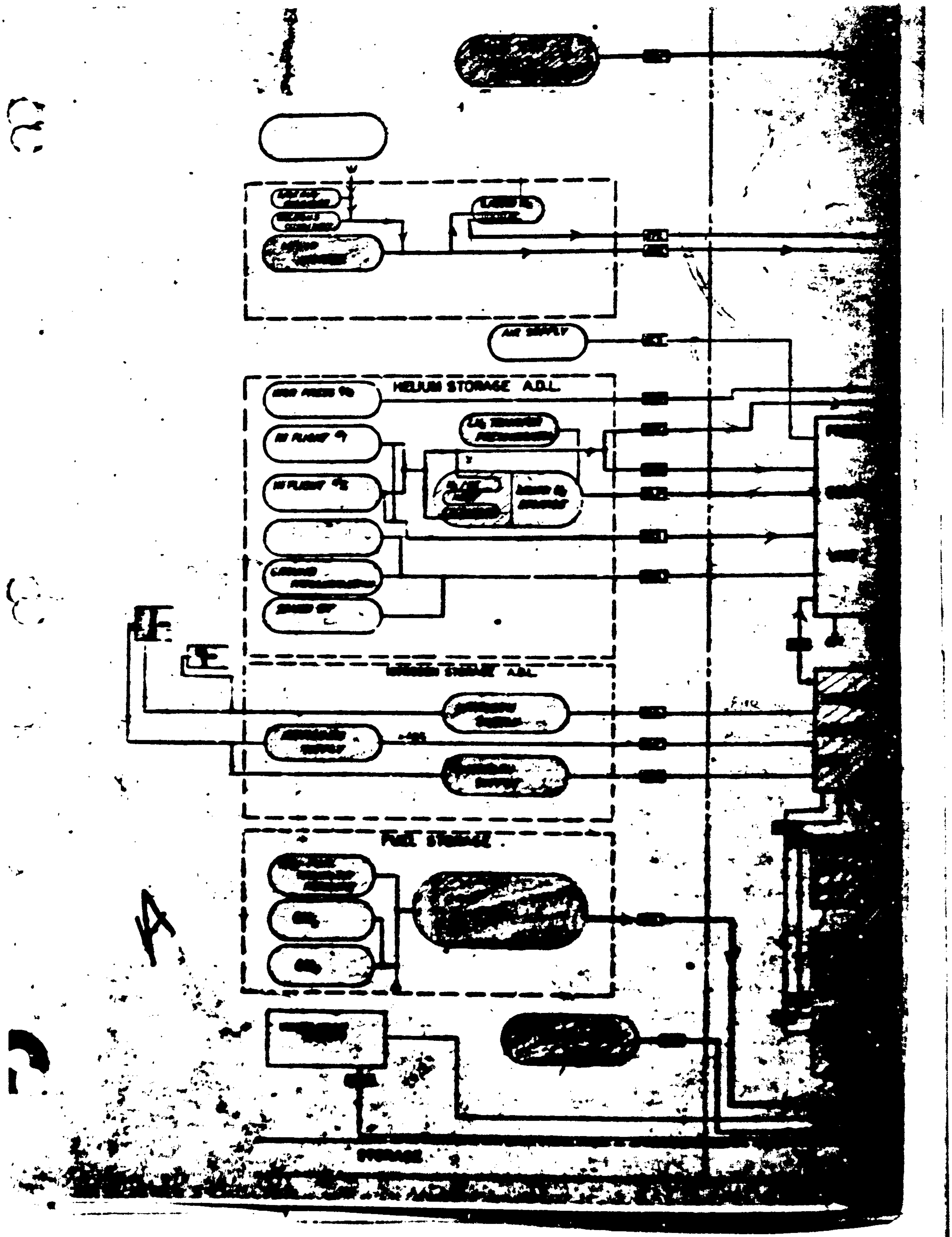
FLOW DIAGRAM OF NITROGEN SYSTEM FOR 65-T COMPLEX

FIGURE M-4

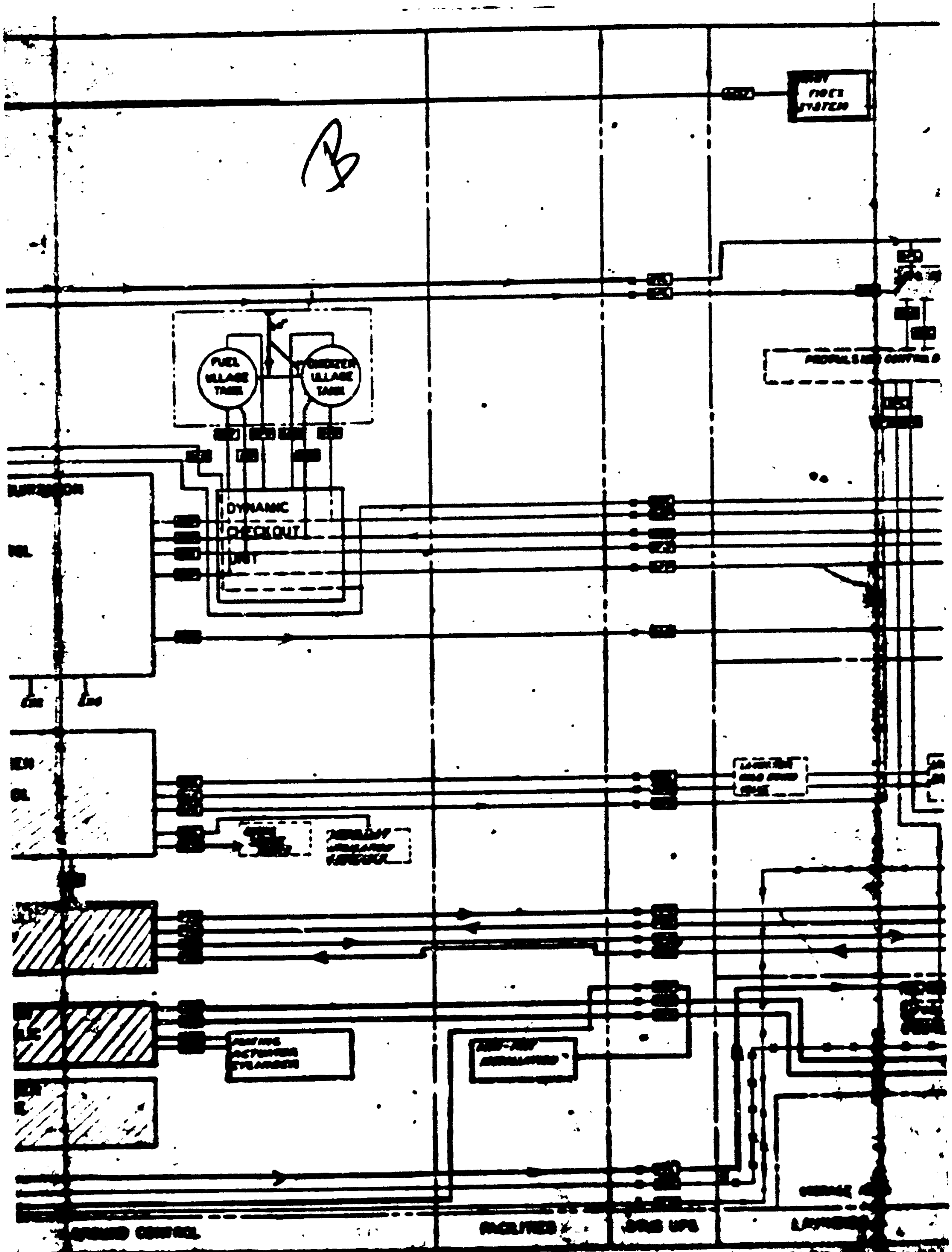


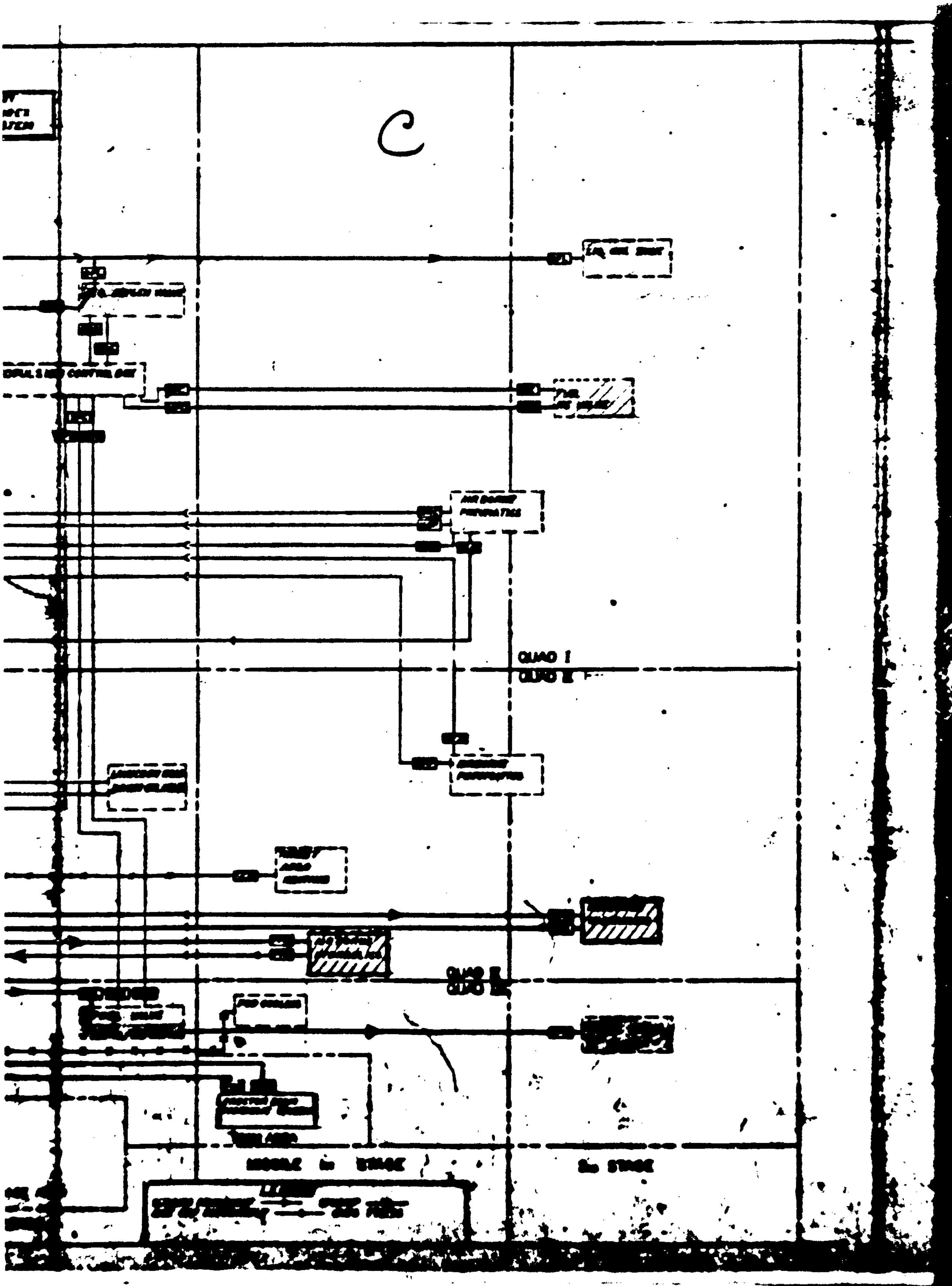
FLOW DIAGRAM OF HELIUM SYSTEM FOR 65-T COMPLEX

FIGURE M-5



HELIUM STORAGE A.D.L.
AIR SUPPLY
FUEL STORAGE
STORAGE


B
FUEL ULLAGE TANK
OXIDIZER ULLAGE TANK
DYNAMIC CHECKOUT UNIT
GROUND CONTROL
FACILITIES

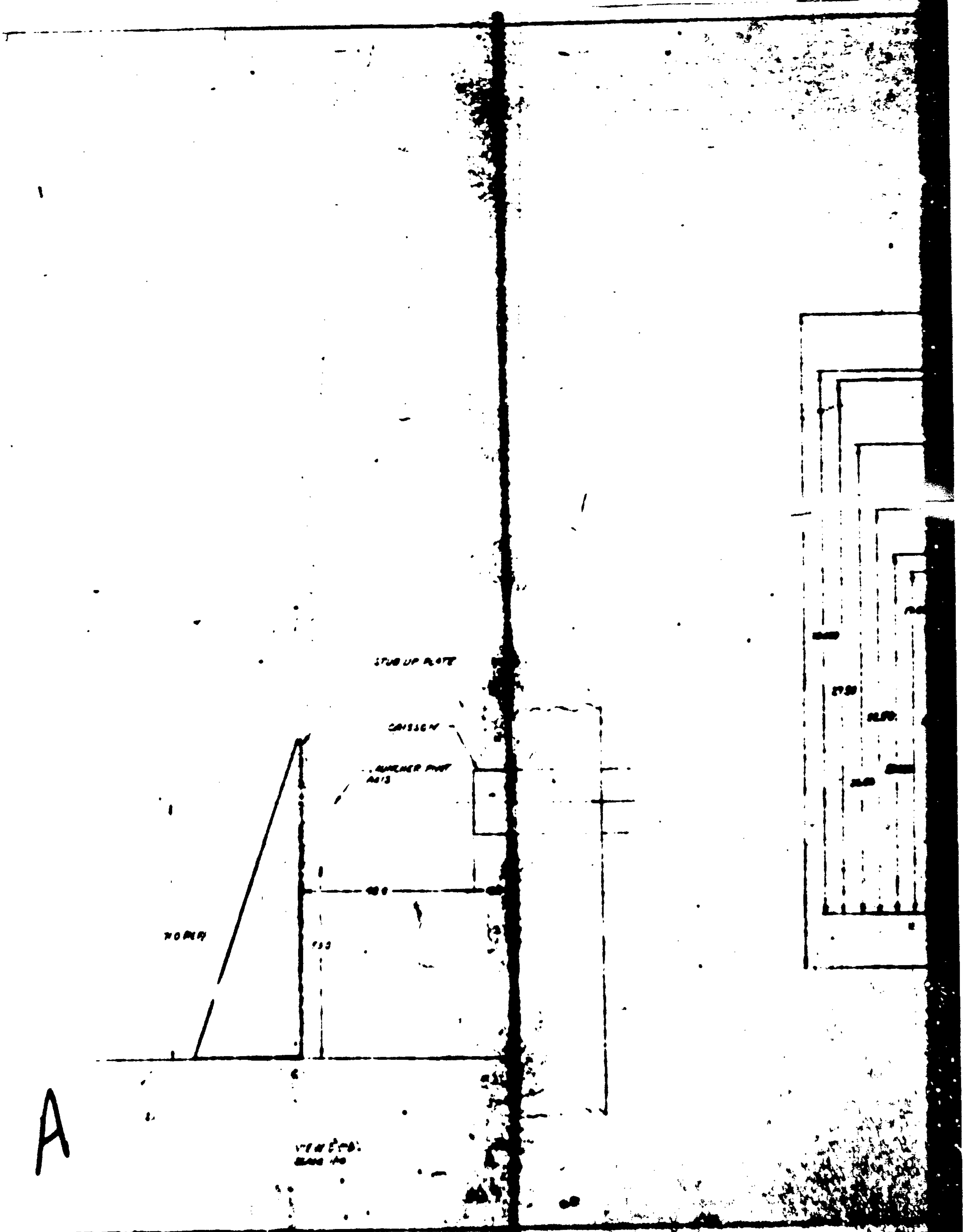

C
QUAD I

[illegible]	[illegible]	[illegible]	[illegible]	[illegible] TYPE	[illegible]	LINE DESIGNATION
[illegible]	50	[illegible]	[illegible]	FLANGED	AIR	COMPRESSED AIR SUPPLY
[illegible]	[illegible]	[illegible]	[illegible]	FLANGED	AIR	AIR TO [illegible] COOLING
[illegible]	[illegible]	[illegible]	[illegible]	FLANGED	AIR	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	FUEL FILL LINE

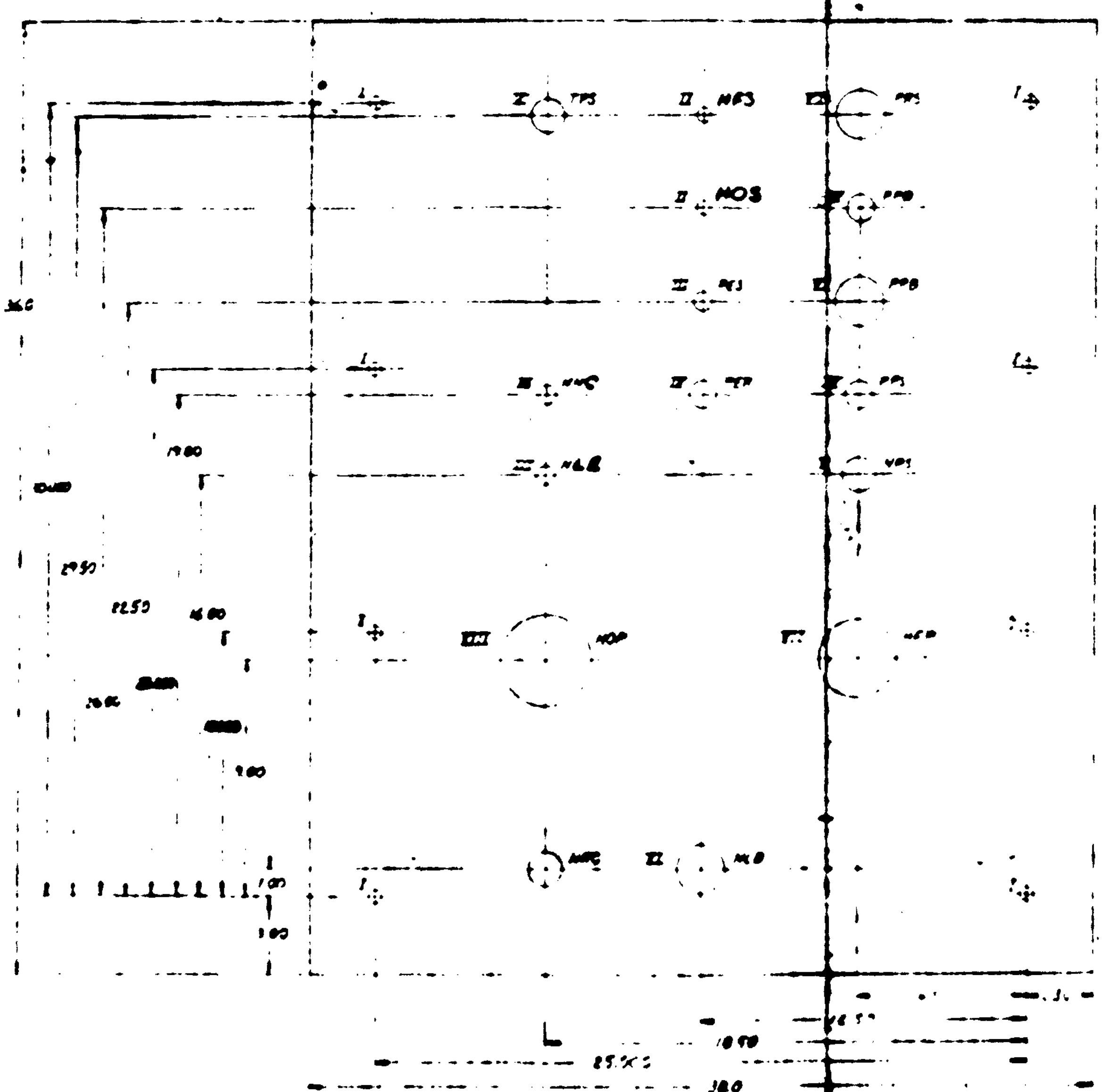
GENERAL SITE SCHEMATIC - FLUID SYSTEMS "E" SERIES

FIGURE M-6 ([illegible])

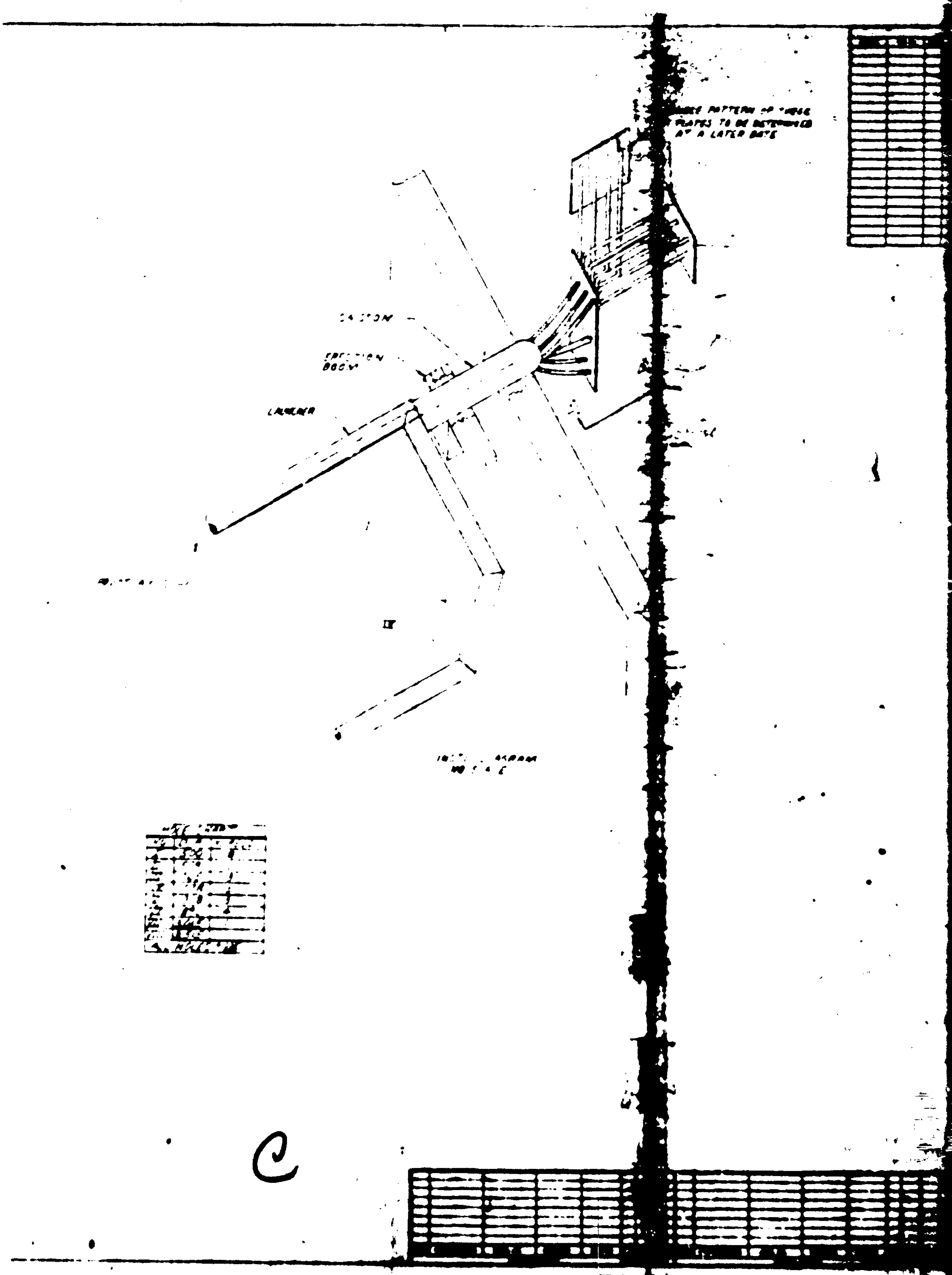
A



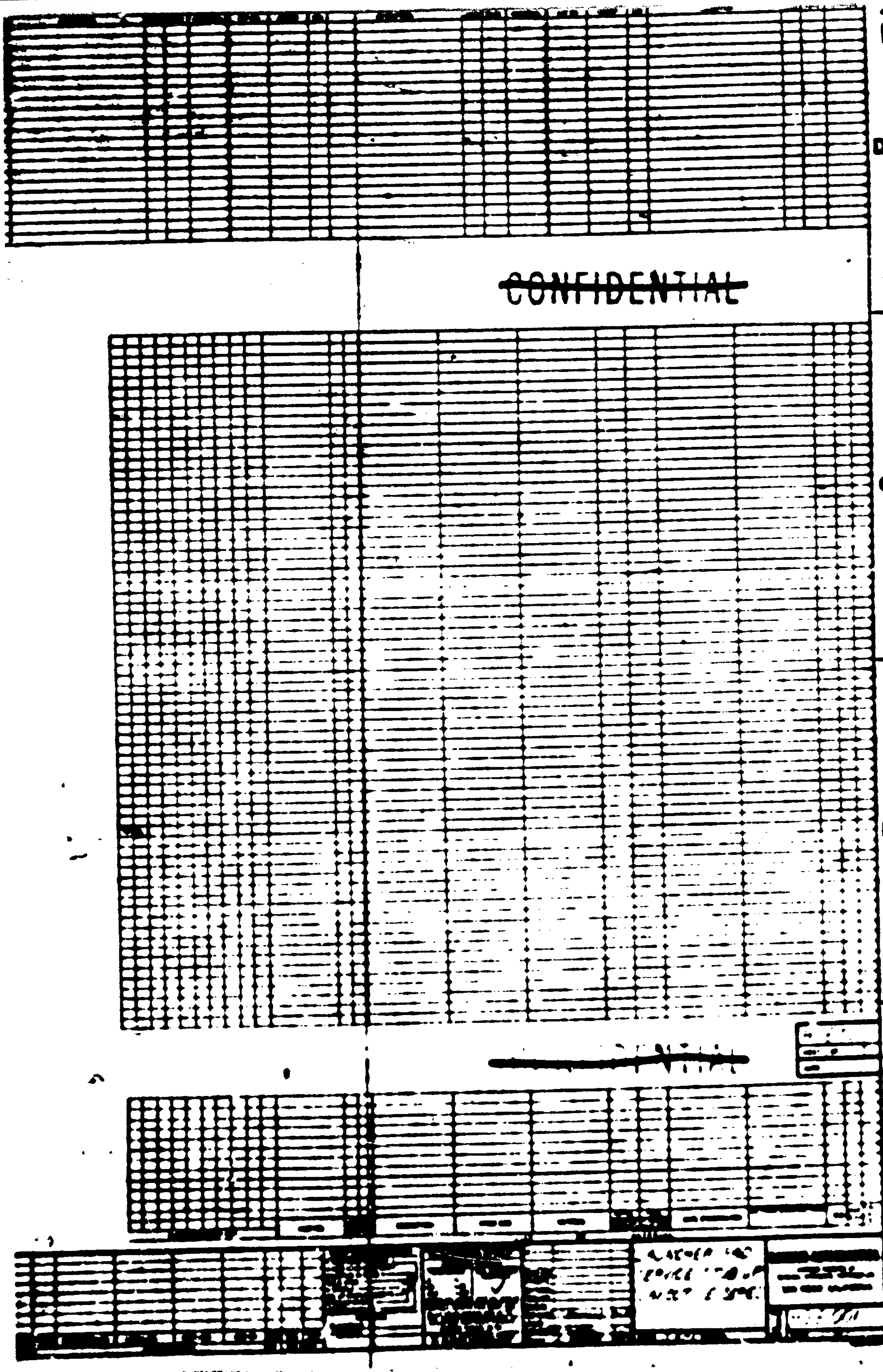
A



B


HOLE PATTERN OF THESE PLATES TO BE DETERMINED AT A LATER DATE
ERECTION BOOM
LAUNCHER

C



D

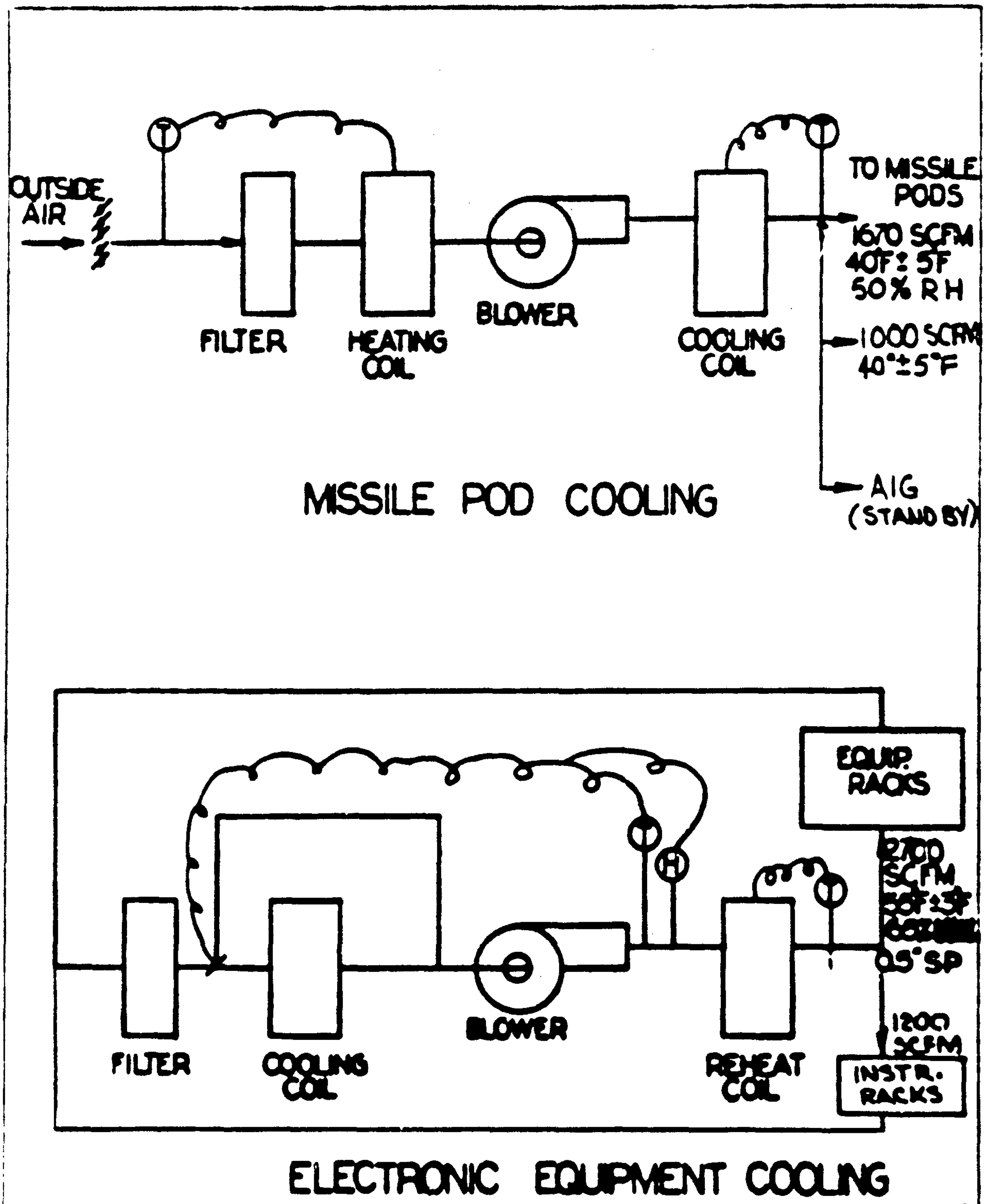

OUTSIDE AIR
FILTER
HEATING COIL
BLOWER
COOLING COIL
TO MISSILE PODS
1670 SCFM
40F ± 5F
50 % RH
1000 SCFM
40° ± 5°F
AIG
(STAND BY)
MISSILE POD COOLING
EQUIP. RACKS
2700
SCFM
.5" SP
1200
SCFM
INSTR. RACKS
FILTER
COOLING COIL
BLOWER
REHEAT COIL
ELECTRONIC EQUIPMENT COOLING

FIGURE M-8

GN$_2$ Storage Requirements

		Lbs.	
1.	Checkout		
(a)	4000 - 1200 PSIG Storage Cylinder		
(1)	Engine Service Trailer	7.4	
(2)	Purge System	185.0	
(3)	Nitrogen Charge Panel Low Pressure	9.038	
	Total		192.4
(b)	8000 - 4700 PSIG Storage Cylinder		
(1)	Booster and Sustainer Accumulators	3.6	
	Total		3.6
(c)	4000 - 2500 PSIG Storage Cylinder		
(1)	P.U. Exerciser	1.0	
	Total		1.0
2.	Leakage and Usage - Twenty Days		
(a)	4000 - 1200 PSIG Storage Cylinder		
(1)	Hydraulic Supply Unit	4.7	
	Total		4.7
(b)	8000 - 4700 PSIG Storage Cylinder		
(1)	Booster and Sustainer Accumulators	1.1	
	Total		1.1
(c)	4000 - 2500 PSIG Storage Cylinder		
(1)	Release System	10	
(2)	Standby Nitrogen Supply to the PCU	13.3	
	Total		23.3

Figure M-8
Sheet 1 of 3

		Lbs.	
3. First Launch			
(a) 8000 - 4700 PSIG Storage Cylinder			
(1) S-T Monopropellant APS		4.6	
	Total		4.6
(b) 4000 - 2500 PSIG Storage Cylinder			
(1) Launcher Release System		6.0	
	Total		6.0
4. Abort			
(a) 4000 - 1200 PSIG Storage Cylinder			
(1) Booster Gas Generator Lox Purge		51.7	
(2) Booster LOX Dome Purge		133.2	
(3) Sustainer Gas Generator Fuel Purge		88.6	
(4) Sustainer Gas Generator LOX Purge		3.7	
(5) Sustainer LOX Dome Purge		66.6	
(6) Vernier LOX Purge		7.4	
(7) Vernier Fuel Purge		5.6	
(8) Trichler Purge		36.4	
	Total		393.2
(b) 8000 - 4700 PSIG Storage Cylinder			
(1) S-T Monopropellant APS		4.6	
	Total		4.6

Figure M-9
Sheet 2 of 3

		Lbs.	
5. Launch Aborted Missile			
(a) 4000 - 1200 PSIG Storage Cylinder			
(1) Booster GG LOX Dome Pre-Ignition Purge		4.4	
(2) Sustainer GG LOX Dome Pre-Ignition Purge		1.8	
	Total		6.2
(b) 8000 - 4700 Storage Cylinder			
(1) Booster Accumulator Charge		3.3	
(2) Sustainer Accumulator Charge		.2	
(3) S-T Monopropellant APS		4.6	
	Total		8.1
(c) 4000 - 2500 PSIG Storage Cylinder			
(1) Launcher Release System		6.0	
	Total		6.0

6. The maximum demand needed in accordance with the established ground rules are:

(a) 4000 - 1200 PSIG Storage Cylinder	
(1) Total (1,2,4,5)	596.5
(2) Recommended Design	700.0
(b) 8000 - 4700 PSIG Storage Cylinder	
(1) Total (1,2,4,5)	17.4
(2) Recommended Design	25.0
(c) 4000 - 2500 PSIG Storage Cylinder	
(1) Total (1,2,4,5)	* 32.0
(2) Recommended Design	40.0

*For release system charge during missile to launcher mating.

Figure M-9
Sheet 3 of 3

HELIUM STORAGE REQUIREMENTS

1. Checkout of Pneumatics Systems on Missile

   A. Fill in-flight spheres to 3000 psi with ambient Helium (through ADL valve H-8 or H-18).............. 51.0#/CO

   B. ADL High Pressure C/O Storage

      1. Raise pressure on in-flight spheres from 3000 psi to 3300 psi.................................. 5.0#/CO
      2. To conduct leak tests on missile pneumatics system.. 0.2#/CO
      3. To overpressurize LO_2 ullage tank and crack airborne LO_2 relief valve...................... 0.3#/CO
      4. To overpressurize fuel ullage tank & crack airborne fuel relief valve...................... 0.3#/CO
      5. To crack fuel pressurization line relief valve in PCU.................................. 0.1#/CO
      6. To flow airborne (in-flight) bottle relief valves... 6.6#/CO

   C. From ADL Storage - "Ground Pressurization"

      1. Pressurize fuel ullage tank to 60 psig.......... 2.0#/CO
      2. Pressurize LO_2 ullage tank to 26 psig.......... 1.8#/CO

   D. To exercise emergency pressurization system & valves... 0.2#/CO

      (This quantity comes to PCU through line H-3)

2. To Launch a Missile Without a Hold

		Quantity
A.	Put in-flight helium aboard...........................	137.0#
~~B.~~	~~For engine start demand~~..............................	~~3.0#~~
B.	Pressurize fuel tank to 30 psig......................	24.5#
C.	Pressurize fuel tank from 30 to 60 psig..............	0.9#
D.	Pressurize LO_2 tank from 2.2 to 26 psig.............	2.4#
E.	Pressurization console leakage.......................	0.3#

3. If a one-hour hold occurs during launch, add:

   A. Engine bleed and leakage.............................. 7.6#/hr.
   B. PCU leakage... 1.2#/hr.

Figure M-10
Sheet 1 of 3

4. To Static Fire (based on one-hour maximum hold)

   A. Load in-flight spheres with refrigerated helium..... 137.0#
   B. For engine start demand.......................... 3.0#
   C. Engine bleed and leakage......................... 7.6#/hr.
   D. Pressurize fuel tank to 30 psig.................. 24.5#
   E. Pressurize fuel tank from 30 to 60 psig.......... 0.9#
   F. Pressurize LO_2 tank from 2.2 to 26 psig........ 2.4#
   G. PCU leakage..................................... 1.2#/hr.
   H. Pressurize LO_2 tank at 2.2 psig during deloxing..... 42.3#
   J. Pressurize fuel tank at 8.5 psig during defueling... 24.1#
   K. Raise LO_2 tank pressure from 2.2 to 5.5 psig for standby........ 6.2#

5. To delox and defuel after aborted flight. (Assumes no LO_2 or fuel used, that missile was completely loaded with fuel and LO_2 and was pressurized to 26 and 60 psig)

   A. Pressurize LO_2 tank at 2.2 psig during deloxing..... 44.0#
   B. Pressurize fuel tank at 8.5 psig during defueling... 25.0#
   C. Raise LO_2 tank pressure from 2.2 to 5.5 psig for standby........ 6.2#

6. Routine uses (extended periods on standby):

   A. PCU leakage..................................... 25.0#/mo.
   B. Propulsion & Pneumatic Valve Leakage.............. 95.0#/mo.
   C. Leakage through fill and drain valve.............. 0.8#/mo.

7. Summary of Data Upon Which the Helium Storage in Enclosure (B) Was Based

   A. High pressure checkout supply (to Dynamic Checkout Unit):
      Requirement per checkout of I.B.1 thru 6. 12.5#
      For two (2) checkout capability = 12.5 x 2 = 25.0#
      Allowance for contingencies = 5.0#
      Total-High pressure checkout supply for DCU 30.0#

   B. In-Flight helium and checkout supply
      In-flight helium requirement of II.A. & B 140.0#
      Engine bleed and leakage for one hour - III.A 7.6#
      Checkout of missile pneumatics system - I.A. 51.0#
      For two (2) launch & checkout capability =
      198.6 x 2 = 397.2#
      Exercise emerg. press. system & valves - I.D. 0.2#
      Allowance for contingencies = 22.6#
      Total-In-flight & checkout supply = 420.0#

Figure M-10
Sheet 2 of 3

C. Engine Controls Supply
Deleted - Engine controls helium to be supplied
from the In-Flight Helium and Checkout Supply

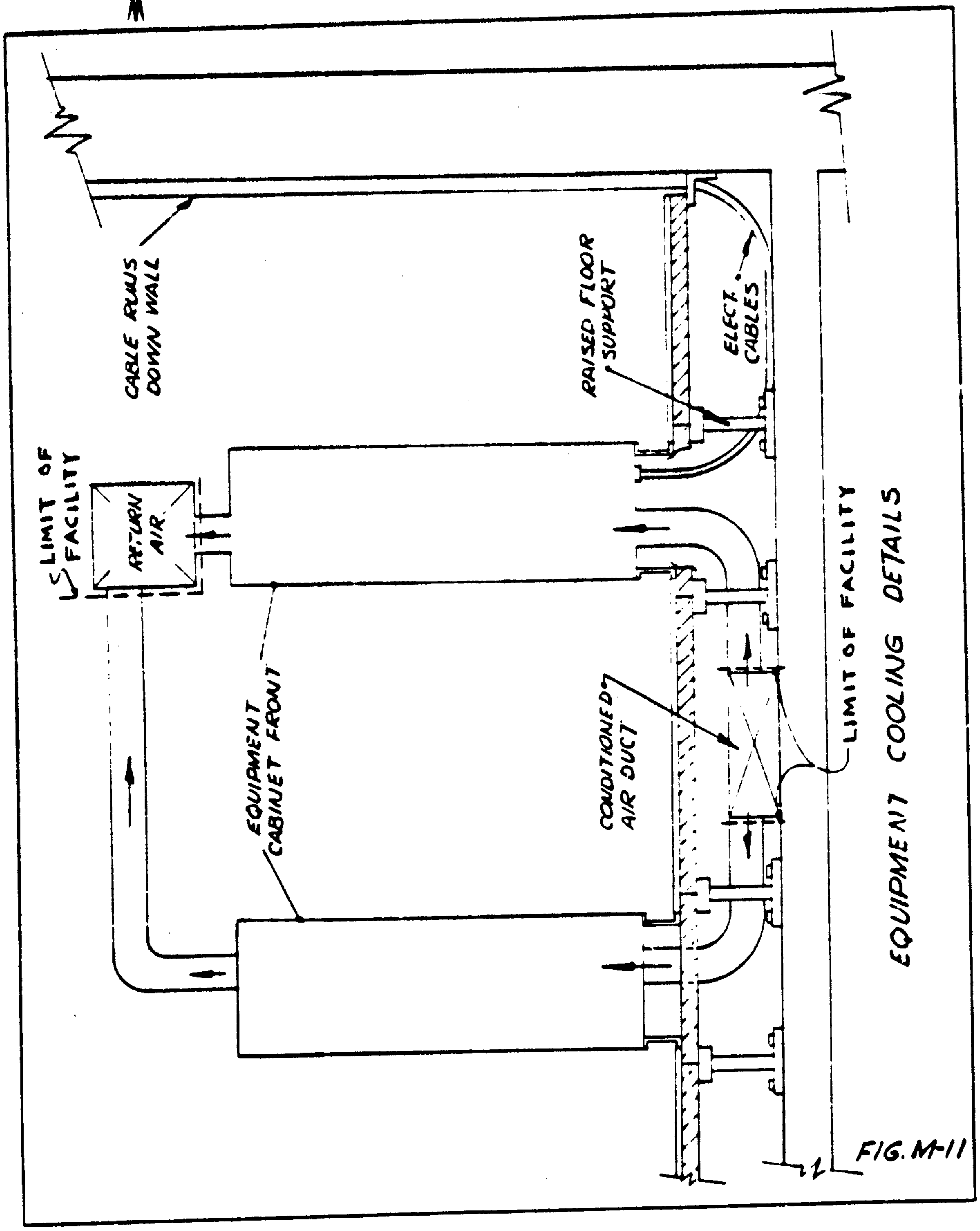
D. Ground pressurization supply
Assume:

1.	One abort (includes one-hour hold): of IV.D thru G and V.A. thru C. =	104.2#	
2.	One launch (includes a one-hour hold): of II.C. thru F and III.B	29.3#	
3.	Check of 2 missiles: of I.C.1. thru 2. x 2 =	7.6#	
4.	Allowance for contingencies	38.9#	
	Total-Ground Pressurization Supply =		180.0#

E. Routine uses supply:

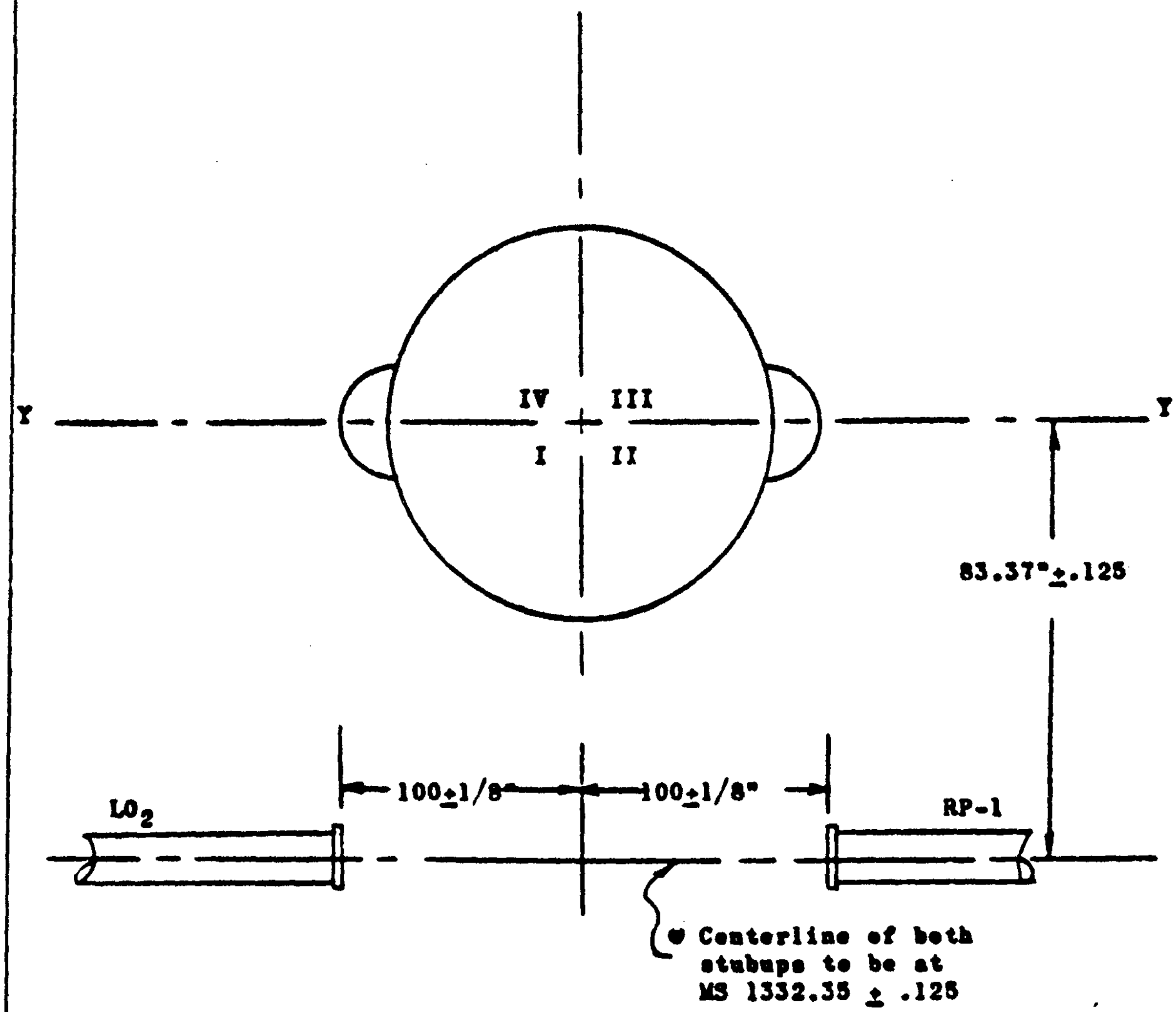
of V.A. thru C. =	120.8#	
Allowance for contingencies =	29.2#	
Total-Routine Use Supply=		150.0#

Figure M-10
Sheet 3 of 3



EQUIPMENT COOLING DETAILS

FIG. M-11

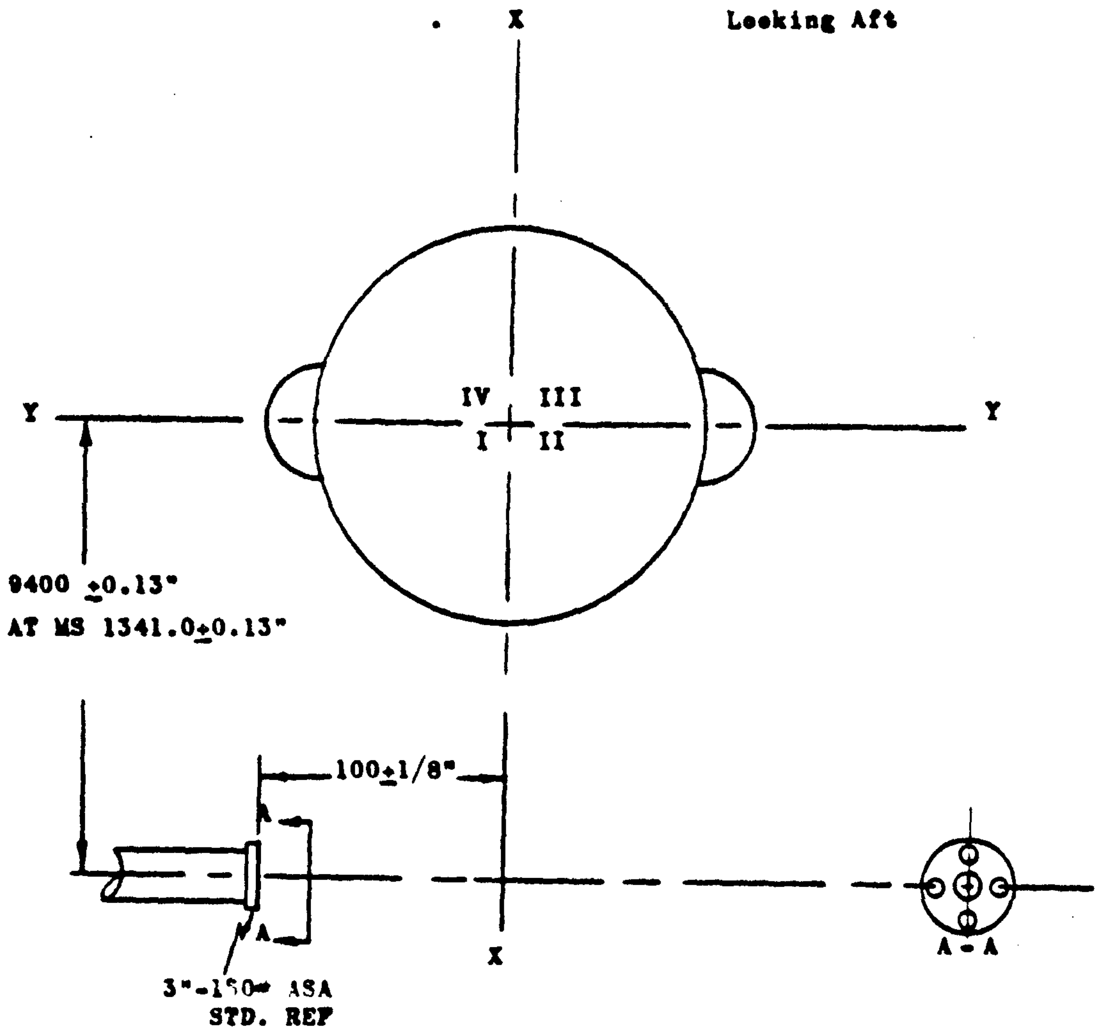


Stubups are to be supported such that no thermal expansion/contractions forces are transmitted through the interface plane.

Size of stubups, type of flange and bolt hole orientations are unchanged from 65-2.

ODTS PROPELLANT STUBUP LOCATIONS

Figure M-12



Stubout is to be supported such that no thermal expansion/contractions forces are transmitted through the interface plane.

E SERIES LO_2 TOPPING
STUBOUT LOCATION

Figure M-13

STORAGE VESSEL REQUIREMENTS

Size	Pressure	Gas or Fluid	Use
28,000 gal.	150 psi	Lox	Missile Load
15,000 gal.	150 psi	RP1	Missile Load
21.6 cf	6000 psi	He	Checkout Supply
300 cf	6000 psi	He	In-flight Supply
106 cf	6000 psi	He	Ground Pressurization
53.5 cf	6000 psi	He	Routine Uses
213 cf	2400 psi	N_2	Fuel Transfer Pressurization
106 cf	2400 psi	N_2	LN_2 Transfer Pressurization
8.6 cf	2400 psi	N_2	Fuel Precharge Supply
27 cf	2400 psi	N_2	Fuel Blanket Pressure
78.6 cf	4000 psi	N_2	Launcher System Supply
32.8 cf	8000 psi	N_2	Charge Panel Hi-press. Supply
10.7 cf	8000 psi	N_2	Release Cylinder Supply
14.5 cf	2400 psi	He	Fluid Transfer Supply
311.25 cf	2400 psi	O_2	Lox Transfer Supply
53.2 cf	2400 psi	O_2	Lox Line Blanket Pressure

Figure M-14

7. ELECTRICAL CRITERIA

7.1 POWER CHARACTERISTICS

7.1.1 ~~Power supplied by the facility shall be as follows:~~

~~440V ± 10%, 3 phase, 60 cps ± 3%~~
~~208V ± 10%, 3 phase, 60 cps ± 3%~~
~~120V ± 10%, 1 phase, 60 cps ± 3%~~

delete; detailed freq. & voltage req. req. at later date.

7.1.2 Special electric power (DC, 400 cps AC, and AC with more critical regulation than that of paragraph 7.1.1) will be provided by special rectifiers, motor-generators, self-contained power supplies, etc. These special power supplies (and distribution systems) will be provided by the contractor that has equipment requiring special power.

7.2 POWER REQUIREMENTS

7.2.1 Power requirements for facility items (heating, lighting, air conditioning, etc.) will be determined by the Architect-Engineer.

7.2.2 The GSE connected load is presented in the following table:

	440V 3 phase (KVA)	208V 3 phase (KVA)	120V 1 phase (KVA)
ELECTRICAL AND MECHANICAL AREA			
Launch Control & Checkout Equip.		1.30	8.00
Power Supply, Ground DC	10		
Charger, Battery	1.3		
Motor Generator, 400 cps, Grn'd Power	5		
APS Voltage Regulator			2
EQUIPMENT ROOM			
Hydraulic Supply Unit	125		
Missile Erection Boom, Hydraulic Power Unit	8		
MISSILE STORAGE AREA			
Erection Boom			
Erection Motor	75 (200 KVA for 5 sec.)		
Re-entry Vehicle Lift Trailer (outlet only)	3		
Engine Service Trailer (Recp. Pyle National P-200186)	25		
GASEOUS OXYGEN STORAGE			
Recharger - Oxygen (Plug Crouse-Hinds DP-20468)	100		
GASEOUS NITROGEN STORAGE			
Recharger - Nitrogen (Plug Crouse-Hinds DP-20468)	100		
HELIUM STORAGE			
Helium compressor (Plug Crouse-Hinds DP-20468)	100		
FUEL STORAGE			
Mobile Fuel Separator (Recp. Crouse-Hinds ARE6425)	4		
TOTAL	572.6	4	26

7.2.3 The maximum load demand imposed during countdown by the GSE at each Launch and Service Building is estimated to be as follows:

See fig E-6. Report ZL-7-038

440V - 125 KVA
208V - 4 KVA
120V - 10 KVA

Hydraulic unit will not be operated simultaneously with Erection Boom Motor.

7.2.4 The electrical demand for facility equipment which must be operated in conjunction with certain GSE must be determined by the A&E.

7.3 GROUND REQUIREMENTS

7.3.1 SIGNAL AND POWER FREQUENCY GROUND SYSTEM

The basic element of the grounding system of the Launch and Service Building is a grid matrix under the building. All equipment, structures, power and signal systems, etc., requiring grounding will be common with the grid matrix.

7.3.1.1 Grid Matrix (Figure E-3)

a. Structure:

1. Grid will be No. 4/0 bare copper conductors.
2. Matrix spacing will not exceed 12 feet.
3. Intersection joints will be brazed (silver brazed, cadweld, or similar)
4. Copper clad steel rods (minimum dia. 3/4 inch; minimum length 10 feet) will be driven in the ground at periphery joint intersections and connected (brazed connections) to the grid.

b. Grid Extensions (Figure E-2):

Flush mounted ground connections (for grounding portable equipment, tools, etc.) shall be installed in the floors or walls inside of the building. Suggested locations for the grid extensions are shown in Figure E-1. It should be noted that since the purpose of the grid extensions is only to provide readily accessible ground points, considerable freedom is permissible in locating the extensions so that they do not interfere with other architectural features of the building.

These ground grid connections will be connected to the grid matrix by 4/0 bare copper conductors.

c. Grid Location (Figure E-3):

The grid shall be at least 18 inches below the floor of the Launch and Service Building. If conflict with a subsurface rock formation is involved, this dimension may be reduced to 6 inches (trenches with protective earth fill added over the grid).

If it is necessary to contour a vertical wall, the spacing between the wall and the grid shall be no less than 6 inches.

d. Grid Limits:

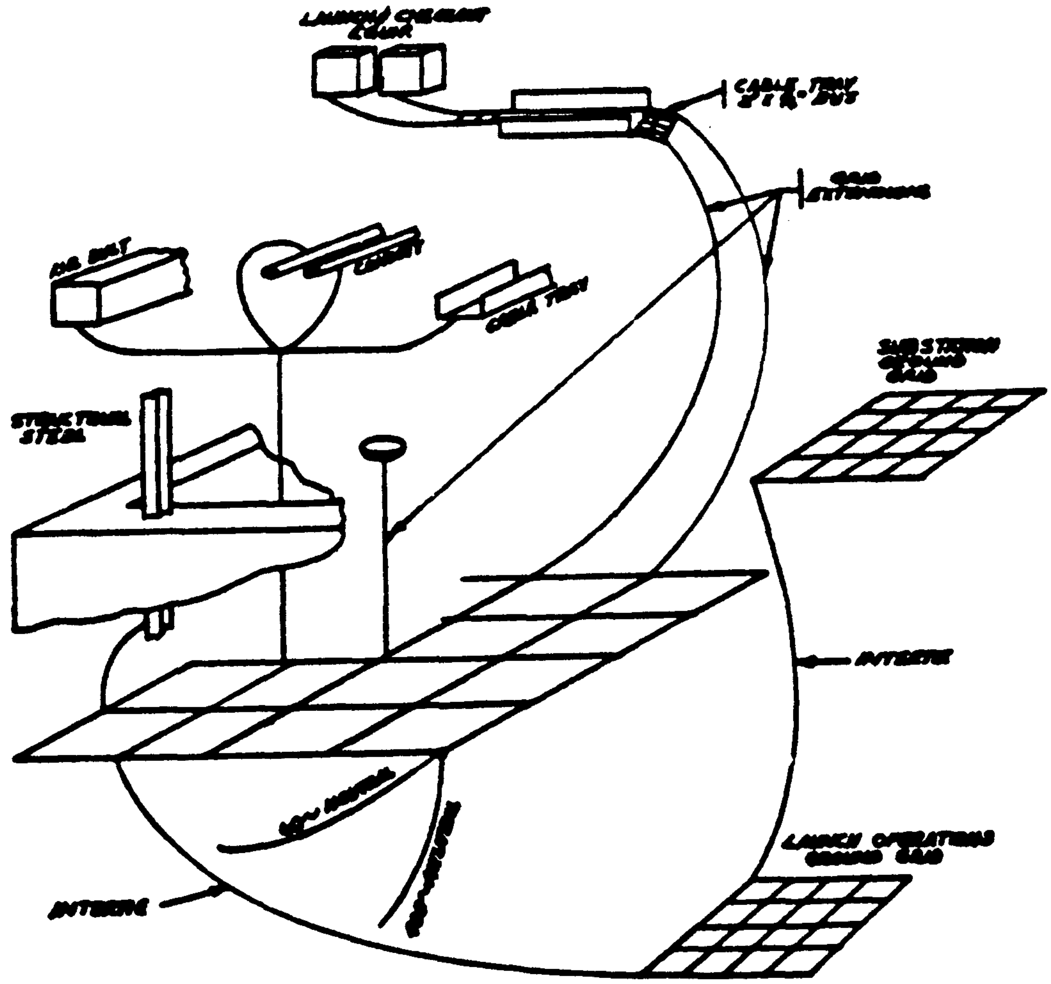
The periphery of the grid will include the area bounded by the outside walls of the Launch and Service Building.

e. Grid Protection:

There shall be an earth fill over the grid with the minimum vertical dimensions as indicated in paragraph 7.3.1.3.c.

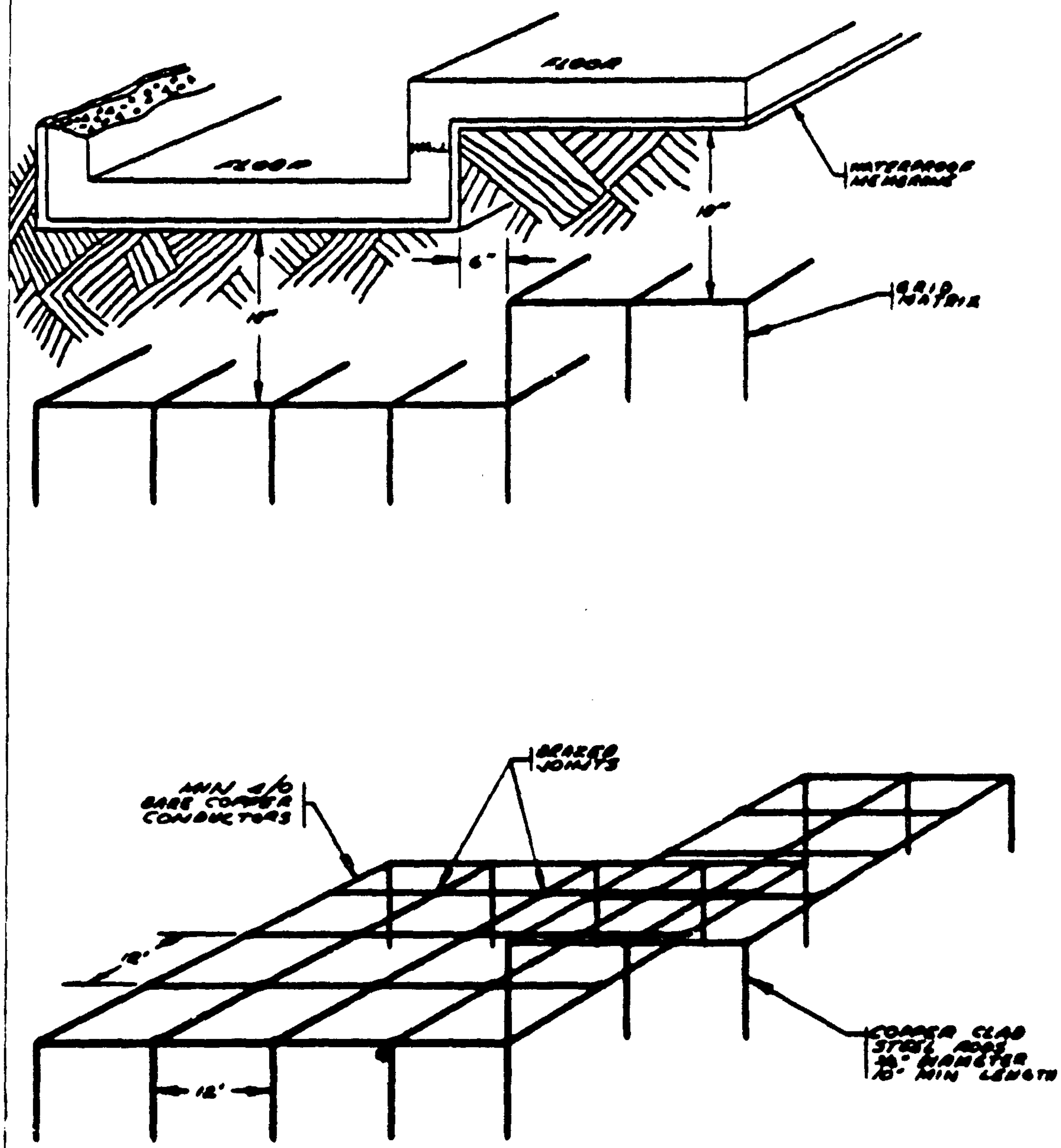
7.3.1.2 Power Distribution System Grounds

a. Initially, the neutrals of the power distribution systems will be grounded only at one point on each major grid matrix (the matrices for the Launch Operations Building and the Launch and Service Buildings).



GROUNDING SYSTEM CONCEPT

FIG. E-2



GRID MATRIX DETAILS

FIG. E-3

In order to avoid circulating currents within a grid, the neutrals will be connected to the same point on a grid. If a water well is used, this point should be as near to the well as possible.

b. Should it develop that after equipment is installed and operated that this grounding is inadequate, additional grounding of the neutrals may be necessary. Installation of this additional grounding will be the responsibility of the contractor requesting it.

7.3.1.3 Interties

a. The grid matrix of each Launch and Service Building will be intertied to the grid of the Launch Operations Building.

b. Each intertie will consist of a minimum of 8 No. 4/0 bare copper conductors.

c. Interties should be buried.

7.3.1.4 Metal Work Bonding and Grounding

a. In order to insure proper functioning of the electronic equipment in the building, it is necessary that large metal objects such as structural steel (excluding reinforcing rods), frames, metal doors, gratings, conduit, duct, cable trays, etc. be provided with a continuous electrical path to ground. Otherwise, these objects may act as antennas and become sources of radio frequency interference. All such metal work should be bonded in accordance with good construction practice and ultimately connected to the ground grid system.

b. Bonding and grounding of the instrumentation consoles and equipment will be the responsibility of the installing contractor.

7.3.1.5 Launch Control and Checkout Equipment

A 1/32 inch by 12 inch copper strap will be run on the floor under the platform supporting Launch control and checkout equipment. One strap should be provided for each row. These straps should be connected to a ground

grid extension at least every 12 feet. Cabinet ground busses will be connected to the ground plane formed by the copper straps.

7.3.2 LIGHTNING GROUNDS

The necessity for general lightning protection for the Launch and Service Building will be determined by the Architect-Engineer.

7.4 LIGHTING

7.4.1 INTENSITIES

Lighting intensities for the areas requiring frequent access for performing maintenance shall be as follows (measured 3 ft. above the floor):

Area	Intensity (ft-candles/ft^2)
Mechanical-Electrical and Electronic Area	25
Missile Storage Area	
(a) Roof closed	25
(b) Roof open	10
Outside perimeter of building and fluid service areas	5

The lighting intensity for the utility tunnels (any maintenance performed in the tunnels will be extraordinary), LO_2 Piping Area, Nitrogen and Helium Area, Fuel Control Area, Air Conditioning and Ventilating Equipment Area, Hydraulic Equipment Area, and the Power Substation Area will be determined by the Architect-Engineer. These areas are such that access to them will be infrequent or the functions performed are such that there are no specific lighting requirements indicated.

7.4.2 TYPE OF LIGHTING

Lighting fixtures must be consistent with MIL-I-26600.

[redacted]

7.4.3 SUPPLEMENTAL LIGHTING

Supplemental lighting will be provided by the employment of portable fixtures. These fixtures will operate on 120 volt AC.

7.5 OUTLETS

Power outlets for portable equipment, trouble lights, etc. will be located about the building. In hazardous areas (LO_2 Piping, Fuel Control, Missile Storage) these outlets shall be explosion proof. 120 volt outlets shall be located at convenient intervals along the walls. Two mandatory 440 volt outlets should be located as near as possible to the positions shown in Figure E-1. (TO BE SUPPLIED)

7.5.1 PROVISIONS FOR SUPPLEMENTAL GRID MATRIX GROUNDING

Provide a ground spool in the wall near each corner of the building for accessible external connection to the ground matrix. These connections will be used for additional grounding if required in the future. Installation of this additional grounding will not be the responsibility of the construction contractor.

7.6 COMMUNICATIONS

7.6.1 DIAL PHONE SYSTEM

A communications network within a complex is required for coordinating routine activities of personnel. This network will also link a complex to other squadron installations. Within the complex this network will be a dial phone system. Installations at the Launch and Service Building will include wall-mounted phones and dial phone communications panels installed in certain equipment cabinets.

7.6.1.1 Wall Mounted Phones

A suggested location for wall-mounted phone outlets is presented in Figure E-1. It should be noted that installations in hazardous areas will in general be explosion proof. Only one phone in the Missile Storage Area will be explosion proof; others will be deenergized during countdown.

7.6.1.2 Cabinet Communications Panels

The locations of cabinet communications panels are shown in Figure E-1. Personnel working in the cabinet area will utilize the communications system by connecting portable handsets to the panels. (FIG. E-1 TO BE SUPPLIED AT A LATER DATE)

7.6.2 PUBLIC ADDRESS SYSTEM

Although there is no technical requirement for a PA system, such a system is considered operationally desirable. Criteria for a PA system is not within the scope of this report; however, a layout of speakers inside the building is presented in Figure E-1, for information purposes. This layout is based on speaker locations of previous installations. Speaker installations outside the building should be anticipated.